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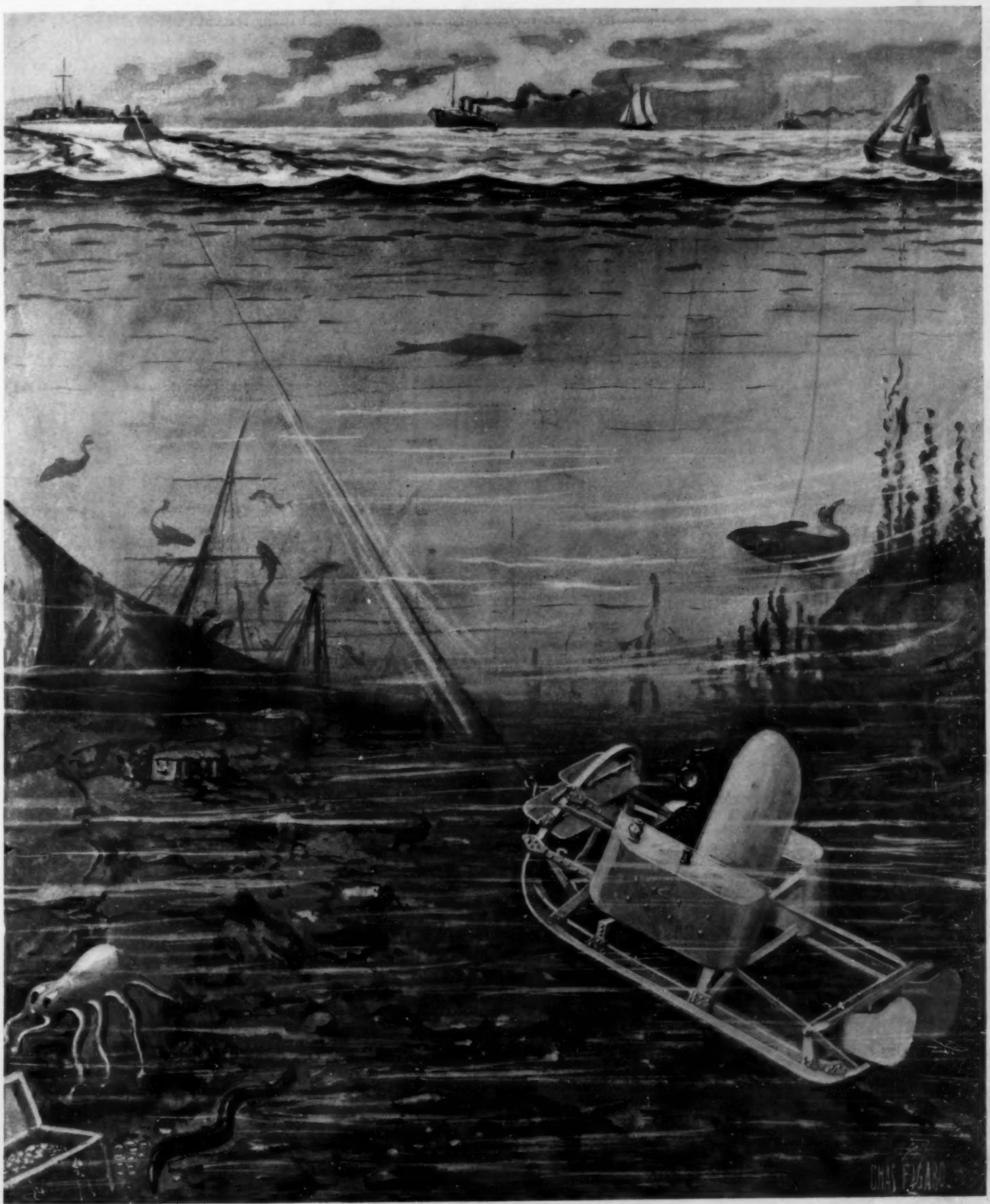

Seated in the sledge, with telephone connection to the towing boat, the diver can travel wherever he pleases, steering up or down or to the right or left.

THE SUBMARINE SLEDGE.—[See page 534.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Bursting of An Army 14-inch Gun

THERE is no branch of the mechanical arts in which the materials and the processes are subjected to more watchful scrutiny than in that of gun manufacture. Particularly is this true of the fabrication of guns of the larger calibers, such as form the principal armament of our battleships and fortifications. Conspicuous in its importance among the departments of a gun factory is the testing laboratory, whose staff of experts keep in touch with the progress of the gun through its various stages of construction, and where specimens, cut from the gun steel are subjected to chemical and physical tests. The system of tests begins in the stock yard, when the pig iron and general scrap which are to be melted down in the open-hearth furnace, are selected with a view to giving the molten steel the desired chemical composition; it is continued during the furnace treatment, specimens being taken from the bath for analysis, until the desired proportions of carbon and other constituents are obtained; and it is followed through the many processes of fluid compression, hydraulic squeezing or hammering, tempering, annealing and hardening, until the finished forging is completed.

Now the whole process of manufacture is closely watched by inspectors, and whenever the laboratory or other tests show that the material or workmanship is falling below the Government specifications the work is rejected. As the result of this close supervision, it is all but impossible for faulty material or poor construction to find its way into a finished, modern gun of large caliber.

Nevertheless, it is conceivable that, hidden within one of the thicker hoops or other sections of the gun, there may exist some local flaw, invisible to the eye, but nevertheless constituting a menace to the safety of the gun of greater or less magnitude—a menace which can be detected only by putting the gun to the test of actual firing. It is chiefly for the purpose of giving the finished gun this final working test that such proving grounds as that of the army at Sandy Hook have been established. If any unsuspected flaw, undiscoverable to the eye, exists, or if there is any error in the calculations on which the gun has been built, it is necessary that it be developed before the gun is emplaced in a fortification. Hence every gun is sent to the proving ground, where it is put through a series of progressive trials, commencing with small powder charges and advancing to and beyond the full charges which the gun is designed to use in service.

Occasionally a gun will burst under test. If this occurs, a board of artillery experts makes a searching examination to determine the cause. If the failure be proved to be due to the design, the design is modified.

The recent bursting of one of the new army 14-inch guns at Sandy Hook should not shake the confidence of the public in the quality of guns which have been built for our fortifications; for it is an assuring fact that, although there have been minor failures at Sandy Hook, due to defective powder giving abnormally high pressures, the blowing off of breech-blocks, the bursting of high-explosive shells within the gun, etc., this is the first time that the gun itself has burst under test, during the several decades in which hooped, built-up guns have been tried out at this famous proving ground.

Big and costly though this 14-inch gun may be, this mishap must be regarded after all as a routine incident of the work at this post. During the past twenty years or more, hundreds of guns of large caliber have passed through the ordeal which proved too much for this 14-inch piece; and until the Board of Inquiry has made its investigation and report we are justified in assuming that the defect which brought about the failure is peculiar to this particular gun, and not common to all the guns of 14-inch caliber.

The 14-inch gun, which was described in our Coast Defense number of May 18th, 1912, will form the principal arm for our Panama Canal and Philippine defenses. Already three guns of this general type have been tested. The original "test" piece, a wire-wound gun, was subjected to 47,000 pounds pressure, which is far beyond the service pressure of 38,000 pounds to the square inch. All these guns went through their trials satisfactorily. The gun which failed had been fired one round with a reduced charge giving 28,500 pounds chamber pressure. For the second round it was loaded with 355 pounds of powder, designed to give a pressure of 38,000 pounds. The men had all been sent behind the bomb-proofs, and Col. Babbitt and two other officers were in the open 250 feet from the gun, watching the target, when the gun burst. The massive fragments flew past the officers; but fortunately not one was injured.

Later, when the official report has been prepared, we shall hope to give the full particulars of what promises to be one of the most interesting explosions in the history of big gun construction.

Are Inventions Ever Willfully Suppressed?

BACK of all the agitation stirred up by Representative Oldfield is the notion that corporations are making a business of acquiring a number of inventions relating to an art and of manufacturing only one or two of them, and of suppressing the rest. During the twenty-six hearings which were recently held in Washington by the Committee on Patents to learn the views of inventors and manufacturers on the provisions of Mr. Oldfield's revolutionary patent bill, sales managers, lawyers, manufacturers, and advertising managers, were asked to mention specific instances of this practice. Even the few witnesses who were in favor of the bill were unable to do so. This vague impression, however, hung like a haze over the discussion until Mr. Thomas A. Edison, with the same keen insight that revealed to him the principle of the commercial telephone, the electric light, the phonograph and nine hundred other inventions, dispelled it with an analysis that was irrefutable. Mr. Edison stated:

"I have heard and read numerous statements that many corporations buy valuable inventions to suppress them, but no one cites specific cases. I myself do not know of a single case. There may be cases where a firm or corporation has bought up an invention, introduced it, and afterward bought up an improvement and ceased using the first patents—suppressed it, in fact. Why should that not be done? It is for the benefit of the public that it should get the latest improvement. I cannot see why the public should be asked to change the patent law to enable a competitor to get hold of the disused patent so that he can have a basis on which to enter into competition with a pioneer of the invention who has introduced an improved machine.

"Before any changes in the law are made, let the objectors cite instances where injustice has been worked on the public by the alleged suppression of patents for other reasons than those which were due to improvements."

Mr. Edison ventured the opinion that the law as it exists is fundamentally sound. "What is needed," he stated, "is not the making of any changes in the fundamental principles of the law, or lessening the consideration granted to an inventor for making his invention publicly known, thereby discouraging and hampering the inventor, instead of giving him encouragement. This proposed new law will discourage the inventor and will benefit the very men that it now seeks to restrain."

Such seems to be the opinion of all the manufacturers and inventors who appeared before Congress in opposition to the proposed patent legislation. And such seems to have been the more sober judgment of the last Congress, as evidenced by its determination not to press these proposals. Let us hope that if the bill is considered by the coming Congress, of which there seems to be every promise, the deliberate judgment of the entire manufacturing and inventing community, as well as of consumers and producers, will not be ignored.

The Status of Electric Cooking and Hot Water Supply

ELECTRIC cooking appliances—the shining nickel-plated or aluminium utensils, including coffee percolators, toasters, chafing dishes, each with its long connecting cord and plug for attachment to the electric light socket—are especially tempting, particularly at this holiday season. The question arises: Are these articles really economical in the present stage of electrical development?

Certainly electric cooking and heating represents an ideal. In the cooking and the hot water supply of the household the need is to get rid of fire risk, to improve the cooking itself, and to reduce the drudgery of housework. Electric devices offer these advantages. In the electric kitchen there are no matches to start a fire, there is no fire risk from the stove itself, there are no gas leaks or explosions. In the quick, but perfectly controlled heat of the electric oven, the juices of a joint of meat are more perfectly conserved, and the meat loses less in weight than in any stove heated oven. In the large electric grill of a well-known New York club a thick steak, placed vertically between two incandescent walls, may be done to a turn in thirteen minutes; the heat sealing the surface of the meat at once and completing the cooking with no scorching, and with no flame to "catch" the fat as it drips down into a pan of water below. Since in the individual devices the heat is generated within the utensil itself the elimination of all smoking or scorching of the outside of the utensil lengthens its life and lessens the work of washing up after meals. One may do "light housekeeping" with a toaster and an egg boiler on the breakfast table and a chafing dish on the sideboard.

But the greater safety and convenience of electric cooking devices, their superior cooking quality, and the greater safety of electric hot water heating cannot be fully realized at present because of the high first cost of the devices themselves, their high operating cost as compared with gas or coal stoves, and the prejudice of servants against them as against anything new and unfamiliar. How can these obstacles be overcome?

As to the first cost of electric devices, it must be borne in mind that since each utensil comprises both the containing vessel and the heating element, the cost can never be as low as that of the ordinary kitchen utensil which it is designed to replace. A considerable reduction in cost may logically be expected, however, with increasing demand, following the present period of exploitation of the general idea of electric cooking and improvement of the devices themselves. The cost of operation is an element of the situation in which very great improvement may be expected. Just as the introduction of the electric light was not prevented or seriously hindered by the greater cost of the new means of illumination as compared with gas, so the advantages of electric cooking may be expected to prevail notwithstanding its greater cost—provided the difference in cost is not too great. To illustrate: it may pay better to toast ten slices of bread, electrically, on the breakfast table, at a cost of a cent than to make the same amount of toast in a slower and less interesting way on the gas stove, with the toast not so inviting or "piping hot," at a saving of a fraction of a cent. But apart from the convenience and economy of time, we may look forward to the time when increasing use of electric household devices will justify the electricity supply companies in reducing their rates for current—or introducing more generally the plan which already obtains in some cities, of selling current for heating and other household uses at a lower rate than current for lighting, each house being wired with a separate "heating circuit" with its own separate meter. The voluntary according of favorable rates will go further toward popularizing electric cooking in our homes than the present extensive boosting of the sale of the devices by advertising. Assuming the cost of electricity to be lowered sufficiently to take away the notion of electric cooking as a luxury, the obstacles presented by the prejudices of servants may be overcome by the fact that the intelligent housewife can get results by the new method and, therefore, can instruct her maid in doing so.

The problem of domestic hot water heating is brought nearer solution by recently developed ideas of using a small but continuous flow of electric current to generate heat which is accumulated or stored in the apparatus. The economy of this system depends on the taking of the electrical energy at those times during the twenty-four hours when the electricity supply companies can afford to deliver it at very low rates, that is in the "valley load" periods, and the success of the system requires the co-operation of the companies.

The Skull of Descartes

A VOLUME published by the Royal Academy of Sciences of Stockholm contains an interesting correspondence between Berzelius and Berthellot, from 1809 to 1822. From one of these letters we learn that the body of Descartes did not reach France in its entirety. A captain of the guards cut off the head and preserved the skull, on which he placed an inscription indicating its origin. The skull was very carefully preserved, and Berzelius sent it to Berthellot. The Academy in turn came into possession of it. Members of the Academy examined it, compared it with a portrait, and declared it genuine, or at least appeared to accept it as such. M. Deherain, the librarian of the Institute, has also undertaken to establish the authenticity of this anatomical relic. After long investigations he was able to discover that the skull of Descartes had been at one time confided to the Museum. It is supposed that the skull was placed in the anthropological collections, and that eventually it found its way to Sainte Genevieve.

Engineering

Stepless Cars in Favor.—The Public Service Commission has granted permission for the New York Railway to issue bonds to the extent of $640,000, the proceeds of which are to be applied to the purchase of 175 new cars of the stepless type recently described in the SCIENTIFIC AMERICAN.

Lattice Masts to be Retained.—As a result of the firing tests carried out some months ago against a lattice mast that had been erected on the "San Marcos," now lying on the mud in Chesapeake Bay, the Navy Department has decided to make the lattice or basket mast the standard type for future warships. The mast, under test, showed remarkable endurance, several successful hits being necessary to bring it down.

Diesel Engines with Electrical Reduction Gear.—The firm of Swan & Hunter are about to build a vessel for the Canadian lake trade of between five and six thousand tons, which will be driven by two 800 horse-power Diesel engines. A novel feature will be the insertion between the engines and the propellers of an electrical transmission system, of the same type that was successfully tried out on the steamship "Electric Arc."

Diminutive Dreadnoughts.—In view of the fact that our latest dreadnought, the "Pennsylvania," will displace over 30,000 tons, it is interesting to note that the Spanish are building a small dreadnought, one of three, which will be less than half her size, displacing only about 15,000 tons. On this displacement, however, she will carry eight 50-caliber, 12-inch guns, and 8 inches of armor and will have a speed of 19.5 knots.

Marine Engines Subject to Duty.—The act regulating Panama Canal tolls does not, as has been frequently stated of late, permit the importation of marine engines. The circular of the Treasury Department limits the materials which can be imported to unfinished forgings, plates and shapes, pipes and tubes of all kinds of metal, bolts and nuts and similar things, but not to any finished or assembled machinery which forms a part of the actual construction of a vessel.

Four-mile Tunnel Through the Selkirks.—At an estimated cost of over $12,000,000 the Canadian Pacific Railway expects within a few years to have opened a two-track tunnel, four miles in length, through the Selkirk range of mountains between Calgary and Vancouver. One object of the tunnel is to eliminate the ever-threatening possibility of interruption from snow-slides, which, on the present line through Rogers pass, have given a large amount of trouble. The tunnel will, of course, be operated electrically.

Question of Statues at Panama.—The suggestion has been made in the daily press that statues to Col. Goethals and Col. Gorgas be erected at Panama, one at each end of the canal. We appreciate the motive, but condemn the practice as here suggested; and we agree with our contemporary, the *Army and Navy Journal*, that it would not be well, even in the case of these officers, to violate the sound rule that monuments should not be erected to living men. The canal is their monument, and an appropriate bronze tablet would be sufficient.

To Depopulate the Canal Zone.—The census of the Panama Canal Zone gives the population there to-day as 63,810, of which about 42,000 are employees of the Canal Commission, the Panama Railroad and of the various canal contractors. Generally speaking, the soil is not suitable for farming. It is not likely that Americans will be attracted; and since other occupants than Americans, for obvious reasons, are not desirable, Col Goethals is in favor of the depopulation of the zone, except so far as it will be occupied by canal operatives and by the military necessary for the protection of the canal.

Death of Alfred Pancoast Boller.—We regret to record the death of Alfred Pancoast Boller, president of the American Institute of Consulting Engineers and one of the country's best known bridge builders, following a year's illness. He was seventy-three years old. Mr. Boller was a native of Philadelphia. He was graduated from the University of Pennsylvania in 1858 and received his engineering degree from Rensselaer Polytechnic Institute, Troy, N. Y., in 1861. He was chief engineer for the Hudson River Railroad for a short time. In 1870 he became vice-president and engineer for the Phillipsburg Manufacturing Company, and for twenty years he was employed by this company. During the same period he was consulting engineer for railroad building in Hayti and Cuba, chief engineer for the Manhattan Elevated Railway and consulting engineer for the Department of Public Parks of New York city. Mr. Boller entered into partnership with Henry W. Hodge in 1898, and they became consulting engineers for the Mexican National Railroad. The firm also was concerned in the construction of the 96th Street viaduct, New York city; the stone bridge over the Connecticut River at Hartford, Conn.; the Singer and the Metropolitan tower buildings and the Wabash Railroad entrance into Pittsburgh, and with the cantilever bridges over the Ohio and Monongahela rivers.

Electricity

A 900-Foot Wireless Tower.—To replace the tower of the German Wireless Company's station at Nauen, which was blown down a year ago, a new tower 917 feet high is being erected. It is expected to have a radius of 6,000 miles.

Snow on High-tension Transmission Lines.—In an article attacking the German requirements regarding aerial transmission lines, which hold that the accumulation of snow on the lines is proportional to the diameter of the wires, Dr. Maguene states that snow never collects on lines carrying 100,000 volts or more, even when they are not charged and are cold. This he attributes to electrostatic action.

New Leadless Storage Battery.—A Swedish inventor has put on the English market a new type of alkaline storage cell. The plates consist of inactive retainers which are loaded with active material, oxyhydrate of nickel mixed with graphite in the positives and finely divided alloy of iron and cadmium and certain other substances in the negatives. This new cell much resembles the Edison cell not only in the electrochemical reaction employed but in the fact that extreme ingenuity is employed in the mechanical construction to obtain high space and weight efficiency and durability.

A Coppered Incandescent Bulb.—A big tungsten bulb in a store window suddenly burned out and passers-by were astonished to note that the bulb took on the appearance of polished copper. Investigation showed that a thin film of copper covered the inner surface of the glass and formed a reflecting surface as fine as any silver mirror. The bulb hung vertically and the larger end was opaque, but the copper coating at the other end was thin enough to see through if held against a strong light. The explanation is simple. When the tungsten filament broke, a short circuit was produced on the copper supports, heating the copper until it vaporized (not difficult in a partial vacuum). The copper vapor coated the glass like so much dust, adhering more firmly, however. Atomized metals are now produced on a commercial scale for coating glass, wood and other objects. The usual procedure is to force the molten metal with a jet of steam against the object to be coated. The steam breaks up the metal into a very fine state of division and the particles adhere very well.

A Speaking Incandescent Lamp.—The incandescent lamp is not the mute electrical apparatus that we have always supposed it to be. It has just been discovered that given the right conditions it may be made to speak as readily as the arc, which for the last fifteen years has monopolized this accomplishment. According to *Physikalische Zeitschrift*, Messrs. K. Ort and J. Ridger have used a metal filament lamp as a telephone receiver. An Osram lamp of 100 candle-power is employed. The lamp is placed in a 120-volt direct-current circuit including a self-induction coil. Shunted across the two terminals of the lamp are a capacity and the secondary of a telephone transformer, the primary of which connects with a battery of five storage cells and a powerful microphone. Words spoken before the microphone are reproduced in the lamp. The discoverers of the speaking incandescent lamp explain the action on the principle that the telephonic current variations superposed on the current that passes through the lamp produce corresponding variations of heat in the filament, which radiating to the glass of the bulb, cause the latter to expand and contract proportionately and thus transmit the vibrations to the exterior air. This effect cannot be produced with 16 or 32 candle-power lamps because the glass is too thick and the heat variations too feeble.

Peace Between the Marconi and Telefunken Companies.—It is gratifying that the patent litigation which has for several years been pending between the two largest concerns in the field of wireless telegraphy, Messrs. Marconi Company in England and the German Telefunken Company, should, at last, have come to an end. It will be remembered that the two companies charged one another with interfering with their respective patent rights and contested the validity of their patents. There are no less than seven lawsuits of this kind pending in different countries. Now the Telefunken Company, with the agreement of the Marconi Company, has published in Germany the following statement: "Messrs. Marconi Company and the German Telefunken Company have agreed to cancel any patent litigation pending between themselves in different countries. The Marconi Company forego any intention of contesting the validity of such Telefunken patents as have been acknowledged by German courts, e. g., the Braun patents." Messrs. Marconi Company, with the agreement of the German Telefunken Company, has published in England the following statement: "Messrs. Siemens Bros. & Co., Ltd., who in England represent the interests of the German Company, have admitted the validity of the Marconi statement No. 7777 of 1900, arrangements being made for settling any mutual patent litigation pending between the two companies."

Automobile

New York's Shows.—The annual automobile shows in New York city will take place in January, on the following dates: 2nd to 11th, show of imported cars in the ballroom of the Hotel Astor; 11th to 25th, double show of domestic cars in Madison Square Garden and the Grand Central Palace.

Ghent to Have a Six Months' Automobile Show.—In connection with the great international industrial exhibition which will be held in Ghent next year, and which will remain open for six months, the Belgian Motor Union will organize a collective exhibit of automobiles, motorcycles and aeroplanes.

Motorbuses Need Many Tickets.—The extent of London's motorbus traffic will be appreciated when one hears that no less than 200 tons of pulp are required to manufacture the tickets for one year's rides. It would be interesting to know how much the New York Subway consumes, because subway tickets, while much smaller, are much thicker than London bus tickets.

Ventilating the Dash Hood of an Automobile.—George W. Dunham of Detroit has patented, No. 1,045,776, a ventilator which consists of a curved deflector embracing the upper edge of the dash hood of an automobile and suitably spaced with portions on both the inner and outer sides of the hood so that the air current induced by the motion of the car will be deflected from the outside of the hood to the inner side thereof to ventilate and cool the portion of the car immediately in rear of the hood.

Hemery Establishes New World's Records.—Victor Hemery, whose thrilling driving in American road races of the past four years is still remembered on this side of the Atlantic, on November 27th broke the world's record for six hours' continuous driving at the Brooklands track in England. At the wheel of a 60 horse-power Lorraine-Dietrich he covered 518 miles in the period at a sustained speed of 86⅓ miles per hour. The former record was 451 miles in six hours.

Segregating Show Cars According to Price.—Because the cheap and medium-priced car naturally suffers somewhat in comparison with very high-priced cars, especially when placed alongside of the expensive product, it has been suggested to divide automobile exhibits in the future according to price of cars, keeping the cheapest in one section, medium-priced in a second section and high-priced machines in a third section. Three separate buildings would be still better.

How a Lost Motor Was Found.—An unusual story of finding lost property comes from England. A repair shop received by express an automobile motor which was to be repaired, but the package contained no intimation of who the sender might have been. In one of the cylinders an old copy of a British motor journal was found and the repairman promptly concluded that the owner of the motor was a reader of that paper. The story was sent to the paper and the owner got his motor back.

Would Charge $25 Admission to Automobile Show.—It has been suggested to charge an admission fee of $25 on a certain day of the next automobile show to be held at Olympia, London. The great crowds which throng the exhibition halls make it impossible for the intending purchaser to examine the cars closely and to get adequate information from the attendants. On the purchase of a car on the floor of the exhibition, the admission fee would be refunded. Losers under such an arrangement would naturally be the accessory dealers who cannot get along without crowds.

British War Office Wants Motor Trucks.—The regulations for the tests which must be undergone by motor trucks submitted to the British War Department have just been issued. The first set of tests, dealing in particular with the standardization and interchangeability of parts, took place in August last, and only two types of trucks succeeded in passing them. A new subsidy trial has been announced for February next, when motor truck manufacturers may submit their vehicles to the War Department's scrutiny. As in the case of France, Germany, Russia and Austria, motor trucks which pass the test will be subsidized.

Taxicabs Need Not Drive in Fog.—That a taxicab need not be driven in a typical London fog, and that the would-be passenger, after being taken for part of the agreed distance, must pay for the mileage covered, is the decision of a London justice. As the story comes from England, it cost the motorist 11 shillings and 8 pence to find it out, while the original taxicab bill had only been 1 shilling and 2 pence. A taxicab driver had been engaged to drive from St. James' to St. John's Wood, but at Clarence Gate the fog was so dense that the driver could not see the hood of the motor. He stopped and refused to drive any farther, claiming it to be too dangerous. The taximeter registered 1 shilling 2 pence, and the passenger refused to pay. The matter was carried to court with the result that the "taxi" was complimented by the judge on his good sense and the passenger ordered to pay the fare and costs.

The Death of Prof. Sir George H. Darwin

PROF. SIR GEORGE H. DARWIN, M.A., F.R.S., LL.D., D.Sc., who died recently, was the second son of Charles Darwin, the great naturalist. The Darwin family for generations has included men distinguished in the arts and sciences; and while the originator of the Darwinian theory, one of the most eminent investigators and thinkers England has ever produced, unquestionably overshadowed the others, it has not been through his reflected glory that his sons took their deservedly prominent position in the world of science.

Sir George H. Darwin was born at Down, in Kent, England, in 1845. He was educated under the Rev. Charles Pritchard, who subsequently became a Fellow of the Royal Society, and the Savilian Professor of Astronomy at Oxford. In 1864 George Darwin entered Trinity College, Cambridge, from which he was graduated in 1868 as Second Wrangler and Smith's Prizeman. From 1868 to 1878 he was a Fellow of Trinity College, and was re-elected in 1884. He studied law, and was admitted to the bar in 1874, but he did not subsequently practice that profession.

In the following year he returned to Cambridge, and devoted his entire time to the study of the mathematical and astronomical sciences, and particularly to experimental investigations on the pressure of loose sands, on changes in the level of the earth's surfaces, and on minor earthquakes. His interest in astronomical and meteorological studies and investigations had been aroused prior to this, and in 1870-71 he accompanied the English expedition to Sicily to observe the eclipse which occurred during that period. In 1882 Prof. Darwin assisted Sir William Thomson (Lord Kelvin) in the preparation of a new edition of Thomson's and Tait's "Natural Philosophy," and in the following year was appointed Plumian professor of astronomy and experimental philosophy at Cambridge, succeeding the Rev. James Challis, M.A., F.R.S., to a chair which Prof. Darwin held with distinguished success. From 1885 to 1905 he was a member of the Council of the Meteorological Office of Great Britain, and he served on the Meteorological Committee of 1905. He was chosen a member and later, in 1879, a Fellow of the Royal Society. He was a president of the British Association for the Advancement of Science, and as the head of that association, he formally opened the Victoria Falls Bridge over the Zambesi Gorge in Central Africa in September of last year. In 1885 he received "a royal medal" from the society for his scientific work, and also one from the Royal Astronomical Society.

Prof. Darwin was an honorary graduate of the universities of Glasgow, Dublin, and Padua, as well as a member of several British and foreign academies of science.

Prof. Darwin's published contributions to scientific literature include papers on consanguineous marriages, for the Statistical Society; jointly with his brother on Small Deflections of the Plum Line Due to Movement of the Earth, British Association Report; a series of reports to the British Association on Harmonic Analysis of Tidal Observations, 1883 and later; several papers on the same subject in the Proceedings of the Royal Society; a series of memoirs on the Effects of Tidal Friction on the Earth and on the Moon, Philosophical Transactions of the Royal Society; papers on subjects cognate to the last, and on Figures of Equilibrium of Rotating Masses of Fluid and on the Mechanical Constitution of a Swarm of Meteorites, Philosophical Transactions of the Royal Society; a paper on Periodic Orbits, in 1896; and one on the Tides and Kindred Phenomena in the Solar System, 1898.

To Our Subscribers

WE are at the close of another year—the sixty-eighth of the SCIENTIFIC AMERICAN's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year.

To those who are not familiar with the SCIENTIFIC AMERICAN SUPPLEMENT a word may not be out of place. The SCIENTIFIC AMERICAN SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

Removing Acid Stains from Instruments

A GOOD method of removing acid stains from laboratory instruments is to rub with pearl ash and then boil for a few minutes in soap water. The instruments should then be dried in magnesia powder and polished with a dry cloth.

Capturing Frost Flowers

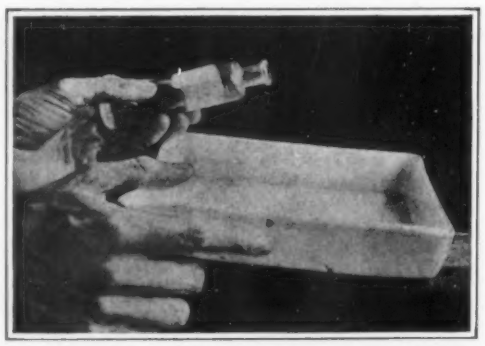
By S. Leonard Bastin

THERE must be few people who have not admired the exquisite patterns which Jack Frost traces with his icy fingers. The thought is irresistible, that it is a great pity the charming flowers are not of a permanent nature. It is all the more interesting to be able to bring forward a scheme whereby it is possible to secure lasting records of the ice designs. This is so simple that anyone can carry it out with good hopes of success, and in this way provide one's self with an absorbing pastime for the winter days.

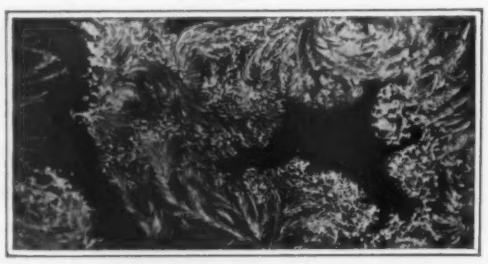
A captured frost pattern in gelatin.

Smearing the piece of glass with the gelatin solution.

The glass should be supported on a cup placed out of doors in freezing weather.



Flooding the plate with absolute alcohol when the frost flowers are well developed.



A captured frost flower.

The frost patterns are most satisfactorily secured on pieces of glass. Before proceeding it is important to see that these are quite clean, and free from any grease. In passing it may be mentioned that a very good glass cleaner is methylated spirit, rubbed on with a piece of crumpled-up paper. Next prepare, or get the druggist to make up for you a solution of two per cent clear gelatin dissolved in distilled water. Also secure a small quantity of absolute alcohol; a few ounces will be all sufficient for the purpose. It is well to get all these things ready in advance, before any attempt is made to take records of the frost flowers.

At a time when there are at any rate several degrees of frost out of doors, we may make the first trial at securing the ice patterns. It is, of course, understood that the gelatin solution, the spirit, and the plates of clear glass, are to hand. If the weather is cold it is likely that the gelatin will be in a partially solidified condition, and in order to make it ready for use it may be necessary to place the bottle in a bowl of warm water for a few moments. When the mixture is fairly liquid a quantity of it may be smeared over a sheet of glass. This is perhaps best accomplished with a good sized brush. In any case it is important that the solution should be spread over evenly, and be quite free from air bubbles.

The best results are secured when the freezing process is as rapid as possible, and it is desirable to support the glass so that it will be in a very exposed position. To bring this about a good plan is to raise the glass on an inverted cup in the manner indicated in the accompanying illustration. Even in a comparatively slight frost, if the glass is placed in this way, a few inches above the level of the ground, the chilling influences of the air will speedily begin to make themselves felt.

It is well to watch rather closely the action of the frost on the gelatin solution. The freezing process should not be arrested until the pretty flowers are well developed, although on the other hand if the action is allowed to continue for very long, the pattern will become too involved for the best effect. When it is considered that the design is at its best, the glass may be taken into a cool room for further treatment. No delay is permissible, as the pattern will, of course, rapidly fade away in a warm atmosphere.

Place the glass in some kind of a dish and immediately flood the plate with the alcohol. For about two minutes rock the dish backward and forward, so as to insure that every part comes under the influence of the spirit. Eventually it will be found that the alcohol will have entirely removed the ice, leaving behind a permanent formation of the gelatin which may, without difficulty, be preserved for an indefinite period. The best way in which to protect the gelatin, which otherwise would be likely to be affected by atmospheric moisture, is to cover it with a film of clear varnish. This should be applied with a good deal of care, in order that the beautiful ice flowers may not be disturbed.

The best results will be obtained if a number of attempts to secure the patterns are made. Thus the sheet of glass may be put out of doors, and if the resulting pattern is not very good, the gelatin solution should be cleaned off and another trial be made. In this way we may be quite certain of getting some very fine pictures. By a few experiments of this nature it will be easy to discover how far the freezing process should be allowed to go.

Of course these captured frost flowers will make the most beautiful transparencies, and as such may be used in the form of window ornaments. Apart from its fancy side the idea has a useful object, as large pieces of glass which could be used for putting in windows may be frosted with real ice patterns. Wherever an undesirable view needs blocking out the result is at once useful and highly decorative. If liked, the effect can be very much enhanced by coloring the gelatin in some bright tint. For this purpose any aniline dye is very useful, the substance being mixed with the gelatin before this is placed on the glass. Most of the brightly colored inks which are commonly sold are practically solutions of aniline coloring, and as such may be used with effect for this particular purpose.

Walter Johnson on October 31st broke the American aeroplane endurance record for a flight with one passenger. He flew a Thomas biplane, and remained in the air 3 hours, 51 minutes and 12 seconds, covering a distance of 235 miles. The course lay between Savona and the village of Bath, New York. The average altitude was about 650 feet.

Fig. 1.—With the Bélin apparatus it is possible to transmit photographs over a telephone line to a distant receiving station.

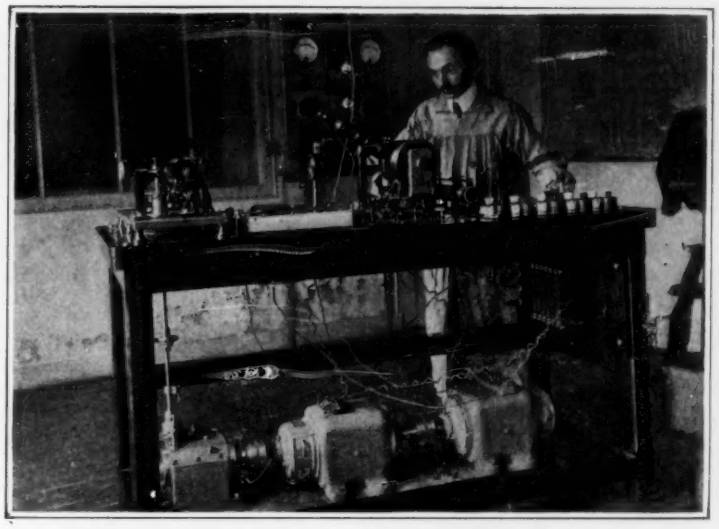


Fig. 2.—The receiving apparatus. A_1 is the oscillograph; B_1 is the photographic frame in which the receiving cylinder is held; C_1 is a lens combined with which is a series of screens; M_1 is an electric motor that drives the apparatus.

Fig. 3.—A portrait transmitted by the improved Bélin telephotographic apparatus in four minutes over a telephone line of 450 miles.

Sending Photographs Over a Telephone Wire

The Improved Bélin Apparatus

By Jacques Boyer

A FRENCH physicist, M. Edouard Bélin, whose remarkable work in telephotography was described in the SCIENTIFIC AMERICAN of December 21st, 1907, and June 12th, 1909, has invented a portable telephotographic apparatus. The new apparatus, remarkable for its small size and weight, constitutes a complete transmitting station, which can be connected up with a convenient telephone line in order to transmit pictures to a distant receiver.

In the so-called carbon process of photography, invented by Poitevin, photographic positives are made on paper coated with sensitive bichromated gelatin, which, as every one knows, becomes insoluble when exposed to light. When the print is taken from the printing frame, it is washed in hot water, the gelatin dissolving more or less, according to the variations in opacity in the negative. As a result the positive obtained consists of reliefs and depressions corresponding respectively with the whites and blacks of the original negative. The halftones lie intermediate between the maximum elevations and depressions.

The bichromate gelatin proof thus obtained is wrapped around the cylinder *A* of the portable telephotographic apparatus (Fig. 4), which is rotated by a powerful spring motor in the drum *B*. The spring, which can be wound up by means of a crank visible in the photograph, also drives through multiplying gears a governor *R*, the purpose of which is to maintain the speed of the cylinder's rotation at a constant number of revolutions. The cylinder's speed is also controlled by means of the graduated index immediately behind the pane of glass at the front of the apparatus. A milliampere-meter *M* is mounted to the left of the apparatus.

As the cylinder *A* rotates, a rheomicrophone *C* is made to travel parallel with it by means of a screw, the principle being much the same as that embodied in the Edison phonograph. The rheomicrophone *C* consists of a frame, box-like in form, the bottom of which consists of an insulated plate, and the cover of which is a flexible conducting sheet of carbon, serving the purpose of translating the variations in relief on the cylinder into currents of different intensity in the line. To carry out that purpose resistances conveniently divided into ten stages are arranged on the insulated plate. The current from a small battery is received by the first resistance, always in contact with the conducting plate, and then flows through the wire attached to the last resistance. Depending upon the amount of pressure to which it is subjected, which pressure is governed by the hollows and elevations of the bichromated gelatin, the conducting plate bends more or less and touches a variable number of resistances, the number increasing with the impulsive force received. Hence currents of successively different intensities are sent through the line. Microphonic contacts are employed in order to obtain better results in the transmission of photographs. It would require entirely too much space to describe in detail all the elements of this portable telephotographic apparatus. It may be stated, however, that perfect synchronism is obtained between the transmitting and receiving cylinders. For the purposes of this article we must proceed to a description of the manner in which the apparatus is utilized.

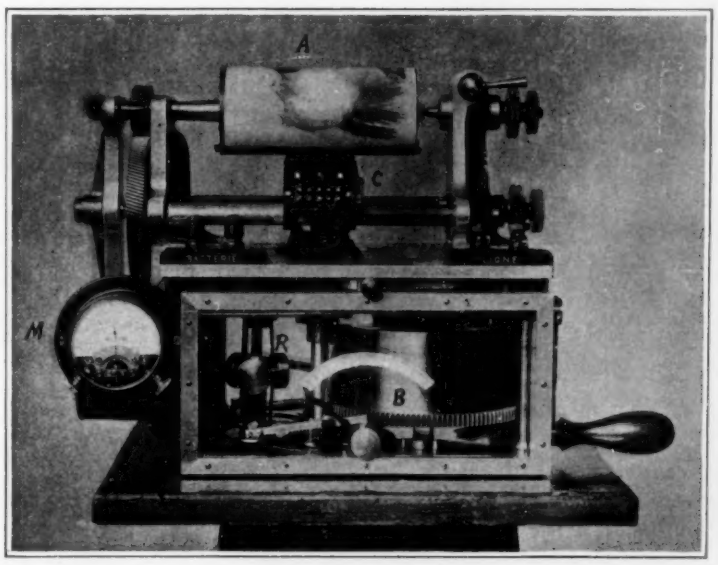


Fig. 4.—The improved Bélin telephotographic apparatus. A is the cylinder on which the original picture is wrapped; B is a drum inclosing a spring which drives the cylinder; C is a rheomicrophone; R is a governor that controls the speed of the cylinder.

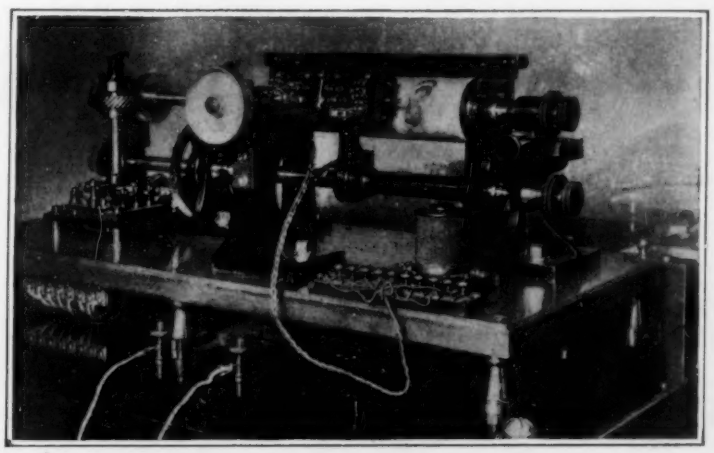


Fig. 5.—The receiving cylinder of the Bélin apparatus. The casing has been removed in order to show the picture that has been received.

After the gelatin bichromate print has been wrapped around the cylinder, it is merely necessary to connect the apparatus with a telephone line. At the receiving station the telephone wires are connected with a large Bélin telephotographic apparatus, on the cylinder of which sensitized paper is wrapped on which the picture is to be received. The paper is protected by a kind of hexagonal photographic frame.

All is now ready for the transmission of the photograph. The operators first exchange the necessary signals and synchronize their respective cylinders. The transmission of the photograph does not in any way interfere with the regular use of the telephone line.

At the receiving station a Nernst lamp is employed as a luminous source. Its rays are projected on the sensitive surface, which is to receive the picture, by means of a Blondel oscillograph. The oscillograph consists of two large coils between which a mirror oscillates. The movements of the mirror are proportional to the intensity of the currents received. The pencil of rays emitted by the Nernst lamp is reflected in a little mirror; then the rays pass through a small apianetic lens C_1 in connection with which the inventor uses a series of graduated screens that enable him to pass from complete transparency to complete obscurity. The receiving cylinder, which is identical in size with that of the transmitting station (Fig. 5), is driven by an electric motor M_1, mounted beneath the table on which most of the apparatus is carried. The motor is very carefully synchronized with that of the transmitter by means of a special rheostat. The cylinder of the receiver, indicated by B_1 in Fig. 2, and shown in detail in Fig. 5, is mounted in a wooden casing. This casing has a circular opening one third of a millimeter in diameter, through which the luminous rays enter. The walls of the casing are

(Concluded on page 553)

The Pier Problem at the Port of New York

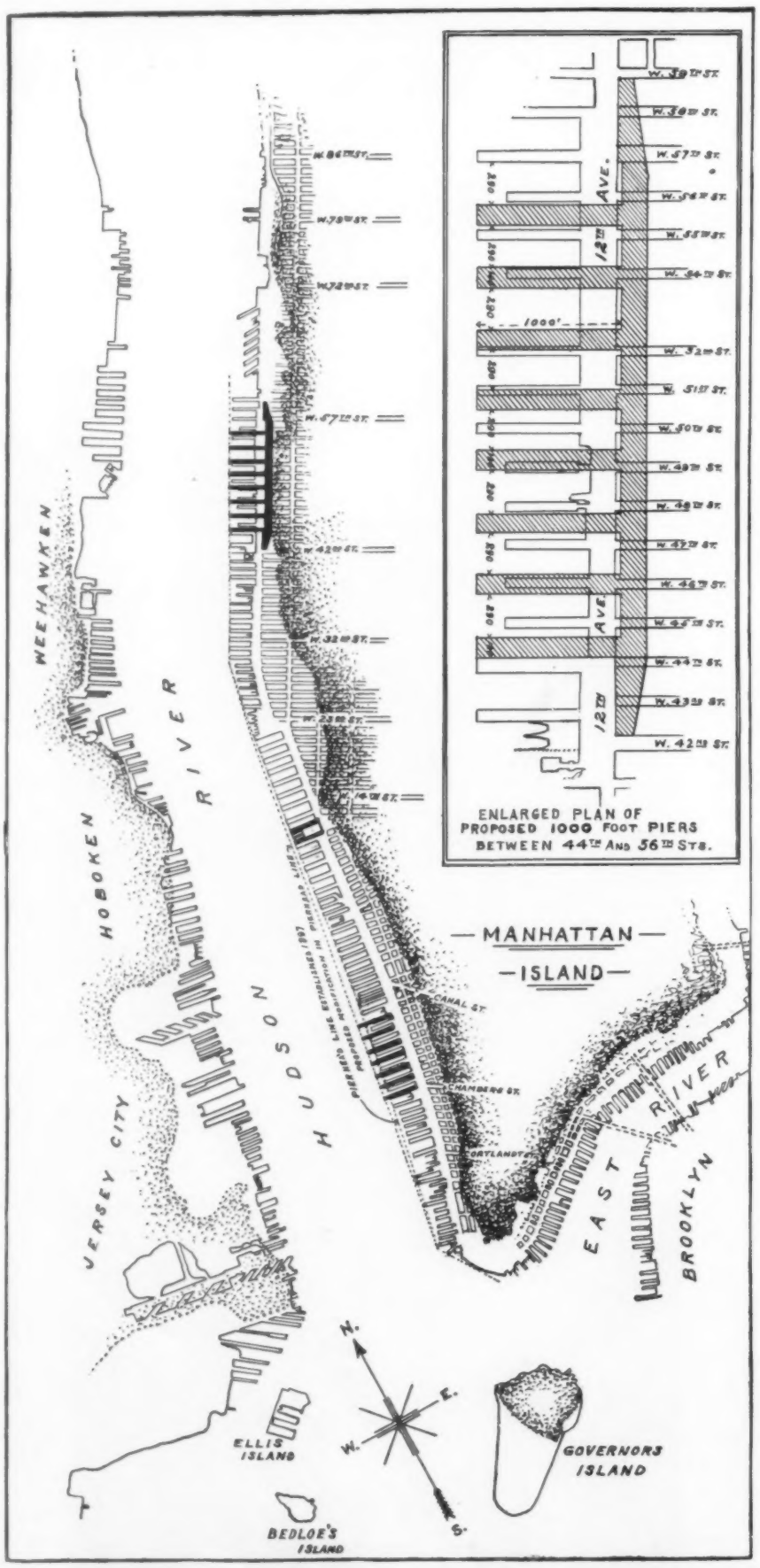
How Manhattan Has Encroached on the Hudson River

IT is probable that few people outside of the historian and the Dock Commissioners have any conception of the great extent to which the bulkhead line of New York city has encroached upon the Hudson and East rivers. They will be surprised to learn that since the year 1626, when the West India Company purchased Manhattan Island from the Indians for sixty guilders, a sum equal to about twenty-four dollars at the present day, the shore line below Chambers Street has been gradually pushed out by bulkheading and filling in, until the area of the island below Chambers Street is approximately 75 per cent greater than it was some three hundred years ago.

At the present time, when the question of bulkhead and pierhead lines along the Manhattan shore fronting on the Hudson River has come up for another and probably its final determination, particular interest attaches to the accompanying map, which shows, by a shaded line, the original shoreline of Manhattan and Jersey City, or rather the shoreline as determined by a survey made at about the time of the Revolution, and also the location of the present bulkheads and pierhead lines, and the proposed modification of the pierhead lines which is suggested by the city authorities and the Governor of the State, and for which Federal sanction is now being sought in a bill before the House presented by the Governor-elect William Sulzer.

The original shoreline as shown on our map is approximately that which was established by nature, with the exception perhaps of some slight encroachments which took place at the lower end of the Island in the days of the original city of New Amsterdam. The water adjoining the highwater line was more or less shoal, the underwater profile of the bottom of the river sloping more or less gradually to deep water; and the motive for encroachment upon the river and bay during the past 300 years has been the same—the desire to provide deep water and pier accommodations for shipping. Moreover, as far back as the seventeenth century, it was realized that the rapid currents of the Hudson and East rivers had to be guarded against, and as early as 1654 it was resolved to drive planks into the shore to make uniform "sheet piles" between Broad Street and City Hall, for the lower part of the city. Several ordinances bearing on the subject of the water front were passed; but the act in 1654 was the first formal attempt to construct a statutory bulkhead. Another motive for the encroachment was the natural desire to increase the area of Manhattan Island. To what an extent this has been achieved a cursory glance at the accompanying map will show.

The bulkhead line along the Hudson River was established by statute in 1871, 1897 and 1904, this last relocation being made between West Twelfth and West Nineteenth streets to accommodate the new Chelsea piers. The pierhead line was first established by statute in 1857. There was a revision in 1890, and the present line was established in 1897. The lines have been carried farther and farther out into the river, to accommodate the ever-increasing growth of steamships. Just how large this encroachment has been will be understood, when it is stated that the present pierhead line between Pier 1 and Fifty-ninth Street is from 1,000 to nearly 2,000 feet beyond the original shoreline of Manhattan, this last figure obtaining in the neighborhood of Twenty-ninth Street, where the original shore line lies fully 1,500 feet inshore from the present bulkhead line. If, in the future, this city should decide to excavate back into Manhattan to accommodate the larger ships that will be built, it will merely be restoring to maritime uses areas which formerly were covered by the waters of the Hudson River.



The shaded line shows the shore line of Manhattan as it existed at the time of the Revolution. The wide belt between this line and the bulkheads at the inshore end of the piers represents "made" land. The proposed 1,000-foot piers are shown in heavy black shading.

The pier problem at the port of New York.

The cause of the present persistent agitation is to be found in the natural desire of the Port of New York to accommodate the ships of unprecedented length which are now being constructed. That fast merchant ships will tend to grow larger, and that the 1,000-foot ship will appear within the next few years, is rendered certain by the economic fact that the larger the ship the less is the cost of carrying a ton of freight or a given number of passengers.

There are two ways in which accommodations can be found; one by a yet further extension of the pierhead line into the river, the other by maintaining the present pierhead line and excavating back into the shore. Several boards have been appointed to look into the question. The Board of Estimate has approved two of the plans suggested; one of which will meet the more immediate and pressing needs of the near future, while the other will make provision for the further increase in the length of ships which may occur during the next two or three decades. Both of these plans are shown upon the map which is herewith published. The first plan, for meeting the immediate situation, calls for a straightening of the pierhead lines between the Battery and Thirtieth Street; a relocation which would make it possible to build between these points some twenty piers, varying in length from 920 to 1,040 feet. The present bulkhead line curves gently inshore between these points, and the running of a straight pierhead line would not narrow the fairway of the Hudson River below the minimum width, which occurs opposite Castle Point on the Jersey shore. The other scheme approved by the Board of Estimate calls for the construction, as they are needed, of piers of from 1,000 to 1,200 feet in length between Forty-fourth and Fifty-sixth streets, the necessary depth to be obtained by excavating inshore. It is the opinion of the SCIENTIFIC AMERICAN that it would be a wise provision for the city to purchase the whole of the blocks lying between Twelfth and Eleventh avenues, between Forty-fourth and Fifty-sixth streets. This would provide accommodation for piers of 1,500 feet length, should future developments in shipping call for them. In this connection mention should be made of the admirable plan of Dock Commissioner Tomkins for an elevated terminal railroad, to extend from Fifty-ninth to Cortlandt Street, with spurs running out onto the piers, and with connections to terminal freight buildings, erected on suitable locations adjacent to the railroad. The construction of this line, together with the straightening of the pierhead line, and the purchase of the property between Forty-fourth and Fifty-sixth streets, would place the port of New York in an unrivaled position.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Flight of Projectiles

To the Editor of the SCIENTIFIC AMERICAN:

In criticising an article on the flight of projectiles, by Rear Admiral Twining, a correspondent in your issue of October 5th complains of the comparison of the twist of a base-ball to the twist of a bullet, on the ground that "a base-ball is rotated on an axis more or less at right angles to its trajectory, whereas a projectile is rotated on an axis practically identical with its trajectory."

If a projectile rotated on an axis absolutely identical with its trajectory, the criticism would be sound, but it is just the slight departure from this condition that causes the drift. The moment the projectile leaves the gun, the force of gravity begins to pull it away from the path of the axis of its rotation, and this slight deviation is enough to make the analogy of the base-ball applicable.

The late Major Lissak, while Instructor of Ordnance at West Point, showed me an apparatus he had constructed to illustrate the drift of a projectile in flight. He had a spheroconical shell mounted in gimbals, so that it could be rotated rapidly and was free to turn in any direction. The resistance of the air to the forward flight was simulated by a hose from a compressed-air tank. Upon directing an air current directly at the point of the rotating projectile, no change in its position occurred. Upon directing the air slightly below the point of the shell, to imitate the resistance due to the fall of the projectile from the prolongation of the axis of the gun, the point of the shell immediately turned to the right. Upon directing the air from this quarter to imitate the resistance to this new movement, the point of the shell immediately turned down. This seemed to demonstrate that the same resistance which caused the drift, further operated to make the projectile follow its point. SIDNEY BALLOU.

Washington, D. C.

The Self-contained Diving Outfit

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of the 5th of October there appeared a notice of a self-contained diving outfit. From the description, the lay-reader would infer that the idea was a new one; this, however, is not the case. There is absolutely nothing novel in the device as described, as you will see on referring to pages 25 and 26 of our catalogue, a copy of which we are sending you by this post. Comparison of the illustrations in our catalogue, which was published three years ago, with that which appeared in your journal will show you the similarity. And further to emphasize the lack of novelty in the apparatus in question, we would mention that we introduced the first apparatus on this principle nearly thirty-four years ago. Used by one of our divers so long ago as the year 1880, it was instrumental in saving the flooded Severn tunnel (*vide* report herewith). See page 172 of "Diving Manual," which we also send you.

Knowing the reputation of your valuable journal, we feel sure that you will give publicity to our statement, and so remove any false impression that may have been formed in the minds of your readers. Just as our Fleuss self-contained breathing apparatus for use in irrespirable atmospheres, introduced by us thirty-five years ago, was the first practicable apparatus of the class using compressed oxygen and caustic potash as revivifying agents, so our original Fleuss diving apparatus (much improved in recent years) must be regarded as the prototype of self-contained diving outfits.

SIEBE, GORMAN & Co., Ltd.

London, England. R. W. DAVIS, Director.

[The catalogue and manual have been received and bear out the contentions of our correspondent.—EDITOR.]

How Would You Converse With Mars?

To the Editor of the SCIENTIFIC AMERICAN:

Suppose that it had been once and for all determined that Mars is inhabited; that signal flashes sent from either the Earth or Mars had been answered by corresponding flashes. How would it be possible to formulate a code which would enable the inhabitants of Mars or the Earth to communicate with each other intelligently? In other words, how could we learn something of the history and the manners of Martian people, and how could we impart to Martians some knowledge of our own political and industrial affairs? It is all very well to send signal flashes through space; but unless we agree upon the significance of the flashes, how will we ever be able to learn something of the personalities of Martians?

It has occurred to me that perhaps we might make a beginning with the representation of geometric figures. If the Martians are intelligent enough to send us signals through space, they are presumably intelligent enough to understand geometry and to recognize the characteristic diagrams of well-known geometric theorems. Thus, waving aside all technical difficulties, suppose we covered a considerable portion of the earth with a huge diagram that would illustrate the theorem: *The square on the hypotenuse of a right-angle triangle is equal to the sum of the squares on the other two sides.* The Martians might reply by exhibiting to us a diagram that would illustrate another theorem in Euclid, thereby showing that they understood at least the principles of Euclid.

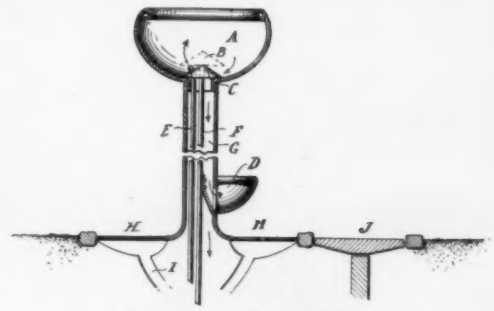
Even with this beginning I find it difficult to imagine the next step. Perhaps some of the readers of the SCIENTIFIC AMERICAN may be able to suggest methods whereby the President of a Martian republic could felicitate the President of the United States on the three hundredth anniversary of the signing of the Declaration of Independence. W. K.

New York, N. Y.

Sanitary Horse Troughs

To the Editor of the SCIENTIFIC AMERICAN:

It has been found that the horse trough has proven a prolific means of carrying infection. Hundreds of horses have taken glanders and all sorts of things *via* that means. Not that the horses touch the iron part of the trough and leave germs there, but simply that a healthy horse drinks immediately after a diseased one and gets the germs, spume, etc., left in the water by the other. The idea suggests itself that the horse be given a hygienic drinking fountain, as is provided for us humans. We can't expect a horse to put his mouth over a little stream shooting in the air, but the device that is roughly sketched herein will do the trick of giving the horse an individual drinking fountain. *A* is a drinking fount of sufficient size to hold a normal drink for a horse, and set high or low as deemed best for checked or unchecked horses. It is set upon a standard *G* that serves as a waste pipe, Inside of this is a supply pipe *E* and a stopped rod *F*. *HH* are perforated drains around a fountain to carry off the water that is slopped over, and *D* is a little dogfount that simply catches the waste from the overflow above. At some



Sanitary fountain for horses.

point near the fountain, where a horse has to place his front feet in order to drink from the fountain, would be a platform device *J*, not unlike a scale platform. Normally, the stopper *C* is in position *D* and the fount is dry. By a simple system of levers, etc., when a horse approaches to drink he is bound to get his front feet on *J* (that yields sufficiently to operate the mechanism, but not enough to bother or fuss a horse) which closes down stopper *C* and opens the valve in *E*, and as long as he stands there that valve is open and the water is running. When he leaves that position the water is closed off, the stopper rises, and the fount is empty of any residue water. Each horse gets a drink of fresh, clean water and the tank is flushed after every drink. The saving of water over the continuous running tank is also an item in its favor. Plus which, it is an anti-freezing fountain. The water valve can be, as in most hydrants, well below freezing and a self-drainer; and there being no water left in the tank, it is a fount that can be kept in operation all winter. And it would be a simple enough matter to so protect *J* that that mechanism wouldn't necessarily fill with water and freeze.

Washington, D. C. F. W. FITZPATRICK.

How are Trees Splintered by Lightning?

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 3rd, 1912, under the heading of Correspondence I noticed a letter from Mr. Austin P. Nichols, entitled "A Notable Lightning Stroke," the point which interests me is in his sentence: "The splintering of the enormous pine tree could well be accounted for by the instantaneous development of steam from the sap in the wood in connection with the air in the tissues caused by the sudden heating by the current."

Now I have actually witnessed the striking by lightning of an "iron-bark" tree which has been ring-barked and dead for thirty years. This particular wood, as is well known, is one of the soundest and hardest in the world when seasoned for so long. The effect of the lightning on this tree was to blast it into hundreds of pieces, the largest weighing no more than ten pounds, from the topmost branch to within eight feet of the ground. It was a tree 70 or 80 feet in height, and the pieces were thrown in every direction, some as far as 160 yards from the base of the tree.

A dead and seasoned "iron-bark" has no sap, and as there was no rain, it being a dry storm, the theory of sudden development of steam would not account for the blasting.

Then, again, the amount of heat necessary to expand the air in the tissues of the tree would have to be terrific, and there was not the slightest sign of burning or scorching. On the other hand, I have seen lightning strike a tree and simply ignite it without blasting it into pieces.

Thus it is reasonable to suppose that Mr. Nichols's statement will not explain my example. I have never heard a satisfactory explanation of the case. Is there one? T. KINGSMILL ABBOTT.

Murralla, Wingen, New South Wales.

Free Will Versus Determinism

To the Editor of the SCIENTIFIC AMERICAN:

I wish to refer briefly to the letter of J. L. Stinson in your issue of October 12th. His observations had for their text the quotation from Dr. Johnson: "All theory is against the freedom of the will, and all experience is for it."

While the statement that all theory is against the Freedom of the Will is decidedly untrue, the second part of the quotation, if reasonably interpreted, must remain an irrefragable proof for Free Will against the arguments of the Determinists. Nor can any scientific or philosophic mind accept the pseudo-parallel argument about the rotation of the sun around the earth, proposed by Mr. Stinson, as disproving the legitimacy of Dr. Johnson's conclusion from experience.

The experience which forces a reasonable man to conclude that he has a Free Will is immediately connected with his inner consciousness. And in purely deliberate actions, such as that of mental attention in recalling the incidents of a past experience or in considering the motives for and against a certain line of action, the evidence for freedom in guiding the mind's activity is so powerful that no one can resist it without mental violence. Anyone can perform an experiment of this kind. The process is so simple and clear of detail, that confusion of experience with inference is impossible. On the other hand, to deny that consciousness is a reliable witness for truth would clearly make all scientific knowledge impossible.

The so-called experience for the sun's revolution is so indirectly and remotely related to consciousness and so irrelevant to the plan of argument that nothing further need be said about it.

Freedom of Will in man is by no means unthinkable, except for those who assume, without warrant, that the theory of materialistic Monism is a proven fact. *A priori* conclusions from unestablished premises are anything but scientific. Ardent pursuers of this method are uniformly unfair to opponents and uncandid in their use of evidence.

It is unfair to say that the advocates of Free Will would make man's actions motiveless. The very opposite is true. They hold that the Will of man is a rational appetency, and simply cannot act without a motive under some aspect of good. They deny, however, that any motive of finite goodness necessarily compels the Will to act. No matter how preponderant the algebraic resultant of motives, measured in terms of pleasure or here-and-now advantage, may be for a certain line of action, the Will may hold out against consent at the expense of great pain. No one could seriously maintain, against the clear testimony of his consciousness in such cases, that he would not be perfectly free to follow the easier course of action.

It is possible and safe to predict how the average man will act under set conditions, because, first, as a matter of fact, very many of man's outward actions are indeliberate, and so are only the response to impulse; and second, as a matter of experience, the deliberate actions of the average man will for the most part be in the line of the algebraic sum of motives, though none the less free for that. These facts, and not the postulates of Determinism, are the basic supposition of social and economic regulations.

The difficulty presented to Determinism by the moral order deserves more serious consideration than the jaunty contempt of Mr. Stinson. The conviction of moral obligation, of responsibility, of merit and desert for deliberate actions, is a fact of inner experience common to all mankind. This appears with the dawn of reason in the individual, and is utterly incompatible with anything save a real freedom of action.

To say that all contribution to advancement in education and social reform has been made on the supposition of Determinism as against Freedom of Will is a purely unsubstantiated assertion, and is in nowise strengthened by the corroboration of one whose claim to authority arises from valuable work in another field.

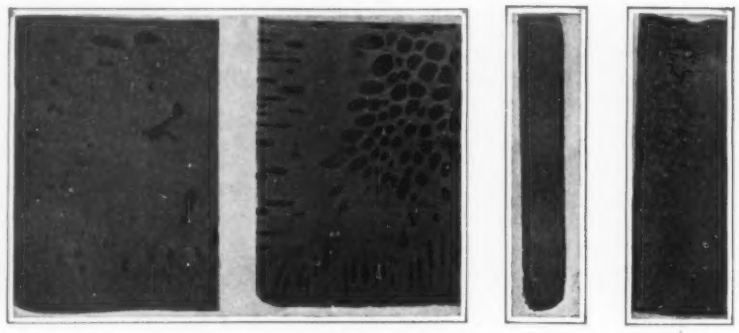
For a detailed discussion of Free Will and Determinism I would refer anyone who is interested to the admirable work of the English psychologist Maher. ("Psychology," Longmans, London and New York.)

St. Louis, Mo. W. H. AGNEW.

Solution of the Steel Rail Problem

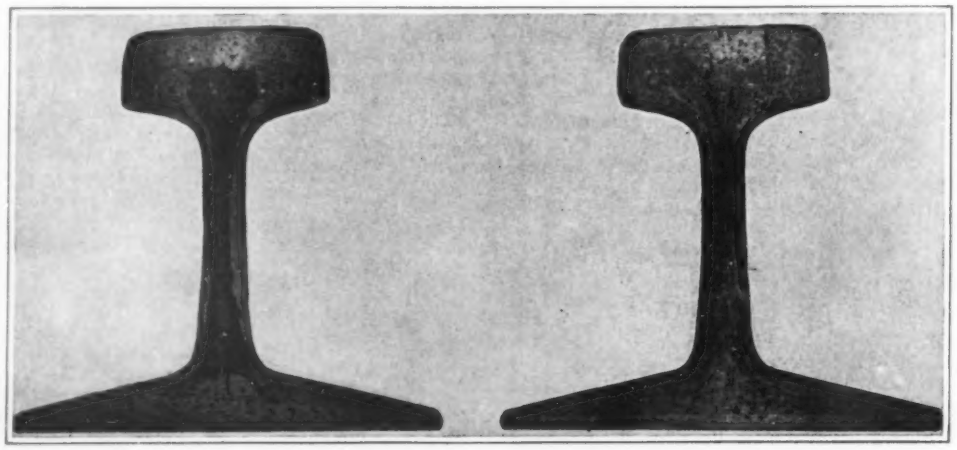
A Method of Producing Sound Ingots

DURING the winter months of 1906 to 1907, there was such an alarming increase in the number of broken rails on railroads that the State Railroad Commission of the State of New York made an investigation and published a report which covered the winter months of 1905, 1906 and 1907. The alarming facts were brought out that the number of broken rails removed from the tracks in 1905 amounted to 1,178, in 1906 to 804, and in 1907 to 2,899, the increase in the number of broken rails in the State of New York in 1907 over those in 1906 being, therefore, about 360 per cent.



Longitudinal and cross sections, showing defects in typical American ingots.

The SCIENTIFIC AMERICAN at that time made a careful investigation of the subject, in the course of which every facility was afforded, both by the engineers of our largest railroad companies and by the leading manufacturers of steel rails. The investigation was made by the Editor in person, and he was given exceptional facilities for examining the private records of the railroads and the minutest details of the process of manufacture by the railmills. The engineers of the railroads stated that they were anxious to secure rails only of the very highest quality, and that, if it should be shown to be necessary, they were willing to pay the highest price which might be demanded for producing rails of the desired composition, strength and wearing qualities. He found that the manufacturers, on the other hand, emphatically declared that, subjected to the conditions imposed by the limitations of the Bessemer process and by the necessity of running their mills at the fullest capacity, in order to meet the enormous demand for rails, they were making the very best possible rail that could be produced. At that time rails were made almost entirely from Bessemer steel, and it was urged that if the open-hearth process were used, it would be possible to secure sound ingots and reliable rails.



Cross sections of American rails, showing how defects in ingots appear in the finished rail.

The SCIENTIFIC AMERICAN found that the deterioration in the quality of the rails in those days was due to the inferior quality of the steel used in their manufacture, and that the inferior quality was due to two facts; First, that the ore from which the steel was being made contained a larger amount than formerly of an impurity which could not be removed by the Bessemer process; and, second, that the manufacturers were using a portion of the steel ingots from which the rails were rolled, which formerly, under the more stringent specifications of the railroad engineers, was rejected and scrapped—this being the upper portion of the ingots containing the deep cavity, or pipe, from which most of the mischief arose. The engineers claimed that broken rails came chiefly from that portion of the ingots which formerly was rejected under their specifications, but which the mills were now incorporating. They stated that, if a larger portion of the imperfect upper portion of the cast ingots were rejected, it would be possible, in spite of the depreciation in the quality of the ores, to roll a rail which would stand fairly well up to its work. On the other hand, the manufacturers understood that if a one third or a one quarter crop were made from the top of the ingots, it would mean an immediate and very large reduction in their output, a reduction which, because of the increasing demand for rails, they were unwilling to make.

We suggested at the time that the proper solution of the difficulty would be to make the one third crop as requested; roll rails of the very highest character that could be secured under the Bessemer process, and in order to meet the slowing down of the speed and the shortage of the supply that would result from these improvements in manufacture, to remit the duty on steel rails until such time as the railmaking concerns should have been able to build up and set in operation sufficient open-hearth plants to supply the full demand of the country.

In the intervening half dozen years or so since we made this investigation, several open-hearth plants have been devoted to the manufacture of steel rails; but it cannot be said that this process has given results commensurate with the expectations of that time. Generally speaking, the open-hearth rail is superior to the Bessemer rail; but it is still subject to the troubles arising from segregation and piping, which are present, even when the open-hearth process is used, and still are to be reckoned as the principal causes of the all-too-frequent breakage of rails.

In their order of importance the defects in steel rails are due; first to pipes and blow holes in the ingots; second, to segregation in the ingots; and, third, to too great haste in the rolling of the rails. The first is by far the most serious. When the molten steel is poured into the ingot mold, cooling at once begins to set in, taking place from the bottom and outside inwardly. The shrinkage of the metal causes the surface of the molten metal to sink, the depression increasing until finally there is a deep, roughly conical shaped hole of large diameter at the top of the ingot and decreasing as it descends, this cavity or pipe extending from say a quarter to sometimes more than half the depth of the ingot. When the ingot is reheated and put through the rolls, the cavity or pipe is closed up; but the temperature of the bloom from which the rail is rolled is not sufficiently high to allow the surfaces of the pipe to be welded together, and, consequently, in the worst cases, there will be an incipient line of cleavage or fracture, extending through the center of the rail, which is generally undiscoverable by any surface inspection. Under the hammering of modern heavy traffic, especially in cold weather, this inherent weakness is revealed, particularly at the ends of the rails, which frequently split open, large sections often being broken entirely away.

Segregation is a tendency on the part of the chemical constituents of the molten steel to become concentrated. The effect is most noticeable toward the top of the ingot, and it has the effect of impairing the reliability of the steel. Many devices have been tried during the past few years, with a view to overcoming the above difficulties. The molten steel in the ingots has been compressed hydraulically both from the top and from the bottom;

First ingot, untreated steel; No. 2, 0.036 per cent aluminium added; No. 3, 0.09 aluminium added; No. 4, 0.09 aluminium and Hadfield top heating, showing absence of piping and segregation.

Pouring the molten steel into a set of ingot molds. Above each is a feeding head, and a bed of slag and blast-heated charcoal delaying solidification of the steel and preventing piping.

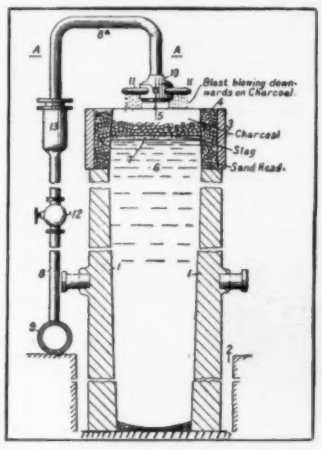
during the settling the metal at the top of the ingot has been kept in the molten state by gas generated heat; ingenious methods have been devised for compressing the steel in the ingots from the sides during cooling. Some of these methods have been illustrated from time to time in the SCIENTIFIC AMERICAN. The objection to most of them has been the heavy cost of the apparatus and the consequent increased cost of the rail.

For some years past Sir Robert Hadfield, the celebrated steel manufacturer, has been carrying on experiments at the Hecla works, Sheffield, directed to the production of perfectly sound steel ingots, and he has met with such success and is so well satisfied with the commercial utility of his methods, that he recently read a paper before the Iron and Steel Institute, which has attracted world-wide attention. The ingots dealt with in that paper are chiefly those of medium size, such as are used for rail production, varying from half a ton to two and one half or three tons each, and from 8 or 10 inches to 20 or 24 inches square.

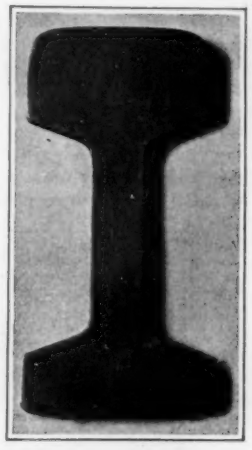
In a recent letter to the Editor, Sir Robert writes: "Judging from the discussion on my paper, there seems to be some misconception in the minds of many that the system I have described covers only the manufacture of experimental ingots. As a matter of fact, at least 15,000 tons have been made, concerning which I believe a record statement can be made, namely, that to the best of my knowledge and belief, not a single one of the ingots in this large tonnage was imperfect." In the address referred to Sir Robert stated that this method made it possible to secure perfectly sound steel, and to do it both cheaply and efficiently. Moreover, the process not only insures sound steel, but makes it possible to use a much larger percentage of the ingots. In many cases, as much as 92 per cent of the fluid steel in the mold is made utilizable; moreover, this is done at small additional expense.

The author of the paper does not deny that large quantities of rails as now made are of excellent quality, but he claims that it is just the "tenth" case which it is important to improve. It is the bad heat here and there, the bad ingots now and then, which gives the fatal rail, involving catastrophe.

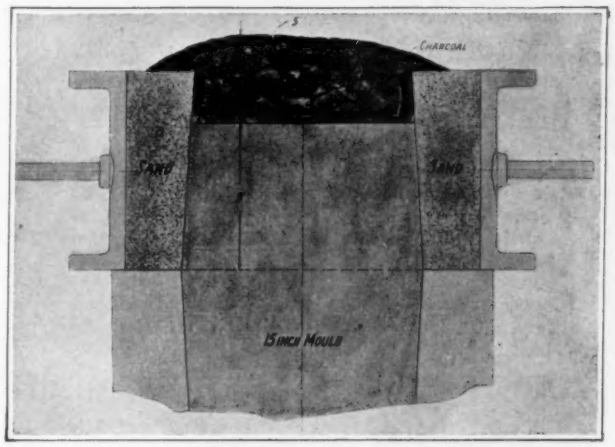
Coming now to a description of the process, attention is drawn to the left-hand illustration at the bottom of page 532, which shows a group of four ingots each about four inches square and thirty inches in length, which were made specially to illustrate and test the question of soundness and piping. All of these show the appearance of the ingots after part of them had been cut away. In the first case, steel was poured into the mold just as it came from the furnace, no solidifying addition being made. The second shows the same steel as the first, except that it was "quieted" by the addition of 0.036 per cent of aluminium; it will be seen that this steel is not quite sound. In the third ingot the amount of aluminium was increased to 0.09 per cent. This steel, it will be observed, is perfectly sound, being free from blowholes, etc., but it pipes deeply. So here the steel maker finds himself in a dilemma. If he makes steel that will not settle, it is unsound. If he makes it sound, it pipes. And since the portion with the pipe in it must be cut away and becomes waste, and must be worked over again in subsequent heats, there is a loss of time. The inventor overcame the dilemma by adding the aluminium and also by using an ingenious and simple method for maintaining the upper portion of the ingots in a fluid condition while the lower portion was cooling and solidifying. This was accomplished by using a sinking head and a method of top heating, as described in this paper, the result being shown in ingot No. 4.



This shows arrangement of ingot mold with slag and charcoal bed and air-blast for preventing pipes.



Polished section of a 95-pound steel rail, rolled from ingot prepared by pipeless method.



Enlarged view of sand-head, showing the thin layer of slag and the bed of charcoal above it.

It will be noted that No. 4 is not only free from the blowholes, segregations, etc., of ingots Nos. 1 and 2, but it is also free from the deep pipe which appears in No. 3. The method consists in heating the fluid steel in the upper part of the ingot, and maintaining it in a liquid condition by the combustion in contact with it, or in close proximity to it, during the cooling and shrinking of the metal in the lower part of the mold, of some form of solid fuel, charcoal, for instance. The charcoal is kept in a state of violent incandescence by means of a blast of compressed air, which is caused to impinge directly on the fuel, while this is directly or indirectly supported by the metal below. Between the layer of fuel and the molten metal is interposed a layer of fusible material, such as cupola slag, which has little or no injurious action on the metal. The slag serves to largely prevent radiation of heat, the loss of which, Sir Robert states, is much greater than is usually supposed. Two illustrations near the top of this page show the arrangement of the air blast, fuel, etc., and note will be taken of the molding-box, placed above the ingot mold and lined with a deep layer of sand, which holds the sinking head in which such piping as may occur will take place.

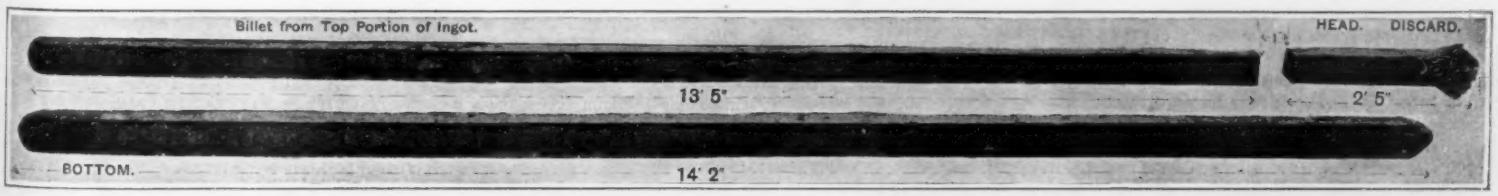
Although the ingots here shown are cast with the small end of the ingot downward, which the author of the paper considers to be the better method, his system can be applied when ingots are cast, as they usually are in America, with the large end downward. For this process, however, he considers that it is better to cast with the small end down, since cooling takes place more quickly, causing the steel to congeal at the lower end and reduce the amount of feeding required later on from the upper portion of the mold.

Compared with the large saving effected by the decreased loss and waste of material, the additional cost of this method is trifling. The quality of the product is improved, and in the case of rail manufacture, not only is there less discard, but the material throughout the whole ingot is sounder. Sir Robert mentions that ingots have been made weighing about five thousand pounds, in each of which the piping and discards did not amount to more than about 7 per cent—a truly remarkable result in ingots of this size. This small loss, moreover, is not the only advantage, the chief one being that the ingot is sound and free from hidden pipes or other defects throughout the whole of its length. On a large output, it is estimated that the saving by this method is from $2 to $3 per ton.

As regards segregation, we are informed that it is almost entirely absent, only a few inches below the sinking head on the top of the ingot being affected. Furthermore, at about four inches below the surface of the sinking head, which is removed before the ingot is rolled in the mills, the percentages of sulphur and phosphorus were practically the same as in the original steel, that is, about 0.03 per cent each.

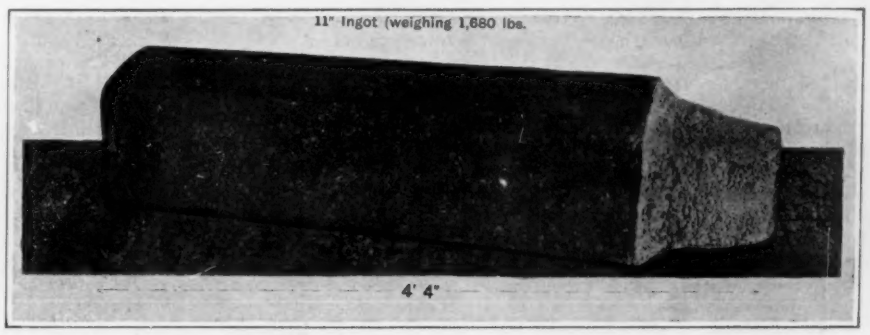
The practical results obtained by this method are shown in the case of two heats which were made of mild steel and two of ordinary steel. In the mild steel the carbon was 0.20 per cent; silicon, 0.40 per cent, and manganese, 0.50 per cent. In the ordinary steel, the carbon was 0.45 per cent; silicon, 0.50 per cent, and manganese, 0.80 per cent. The ingots were prepared in the manner described above. The results obtained are given in Tables I and II. Fourteen ingots

(*Concluded on page 543.*)

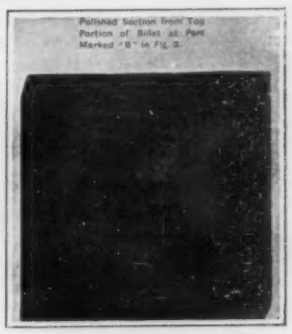


Two billets rolled from the 11-inch ingot below. Note the small discard.

Section of above billet 2 feet 6 inches from head, showing no trace of pipe.



Eleven-inch ingot, weighing 1,650 pounds, cast by the delayed-cooling method. When this ingot was rolled down into blooms aggregating thirty feet in length it was necessary to discard only two feet six inches.



Section of above billet 2 feet 5 inches from end, showing last trace of pipe.

Col. Gorgas Receives the Buchanan Medal

IN conformity with ancient custom the Fellows of the Royal Society met on St. Andrew's Day on the occasion of their anniversary for the purpose of electing a new council and to hear the presidential address. At a point in the discourse from the chair the gold medals at the disposal of the society are bestowed upon the respective recipients. Special interest attached this year to these gifts from the fact that the Buchanan medal was awarded for the first time to a distinguished American scientist, viz., Col. William Crawford Gorgas, assistant surgeon-general of the United States Army.

The medal in question was founded in 1894 in honor of Sir George Buchanan, F.R.S., an eminent London physician and sanitary reformer, who died in 1895. It is allotted every five years for notable service in hygienic science or practice, in the direction either of original research or of professional, administrative, or constructive work, without limit of nationality or sex.

The award to Col. Gorgas is made on the ground of his sanitary administration of the works of the Panama Canal. Appointed chief sanitary officer at Havana, Cuba, in 1898, he, there, for the first time, applied the sanitary methods which enabled the American Government to clear yellow fever almost entirely from Havana. In 1903 he was promoted to be colonel assistant surgeon-general by special act of Congress for his yellow fever work in Havana. In 1904 he assumed duty in the Panama Canal Zone. Col. Gorgas has carried out sanitary work in the tropics on a grand scale. He has been called upon, moreover, to lead the way in the prevention of a new class of diseases, namely, those that are carried by insects. In organizing this departure he was obliged to employ new weapons under new organization, requiring fertility of resource and determination in the face of innumerable difficulties. His success at Havana was undoubted; and since his transference to Panama he has still further advanced the technique of tropical sanitation.

The other medallic awards made by the society were as follows: The Copley medal to Prof. Felix Klein of Göttingen, for his researches in mathematics. The Rumford medal to Prof. Heike Kamerlingh Onnes, for his researches at low temperatures. The Davy medal to Prof. Otto Wallach of Göttingen, for his researches in chemistry. The Darwin medal to Mr. Francis Darwin, F.R.S., for his work in conjunction with Charles Darwin, and for his researches in vegetable physiology. The Hughes medal to Mr. William Duddell, F.R.S., for his investigations with technical electricity. His Majesty the King approved the award of a Royal medal to Prof. W. M. Hicks, F.R.S., for his researches in mathematical physics; and a Royal medal to Prof. Grafton Elliot Smith, F.R.S., for his investigations on the comparative anatomy of the brain.

The Motion Picture Film in Court

AN appeal taken from a decree on a bill by the Motion Pictures Patent Company against the Chicago Film Exchange for infringement of patent 589,168, granted to Thomas A. Edison on August 31st, 1897, resulted in a reversal of the decision of the lower court, and in a declaration that Thomas A. Edison was not the pioneer inventor of the moving picture film. In the patent in question, claims 1, 2, 3 and 4 cover the camera and claims 5 and 6 the film. A claim covering the photographic film seems to have been the bone of contention. The Court said:

"The flexible, transparent or translucent tape-like film prepared for taking photographs was not discovered or produced by Edison. It was brought to its present state of perfection by Eastman. . . . He (Edison) provided it with perforations along the edges at regular intervals into which the teeth of ratchet wheels of the camera entered to give it the required motion; a mechanical contrivance to adapt it to the performance of the functions of the machine. This co-operation of the rows of holes with the teeth of moving wheels he had described in a caveat in 1889 as similar to that in the Wheatstone telegraph instrument for insuring positive run of the band. Moreover, perforations had been previously made in photographic films for feeding purposes. . . .

"We do not dissent from the proposition that Mr. Edison solved the problem of the motion picture art with great ingenuity and skill. But the problems that he solved were in the camera apparatus, wherein his true claim to invention lies. . . . The long, pliant, translucent, celluloid film with the sensitized surface was the invention and improvement of others. The pictures taken on such a film are photographs. It is the particular character and arrangement of those pictures for which Mr. Edison is entitled to credit. But those pictures and their arrangement are nothing more than the result of the operation of his improved camera apparatus. The problem that was solved by their production and arrangement was a problem of the camera machinery. . . .

"The invention of Edison was exhausted in the construction of the camera which enabled the photographs of moving objects to be taken upon the Eastman film in the distinct, uniform and satisfactory manner justly claimed for them. The pictures taken are the direct result of the mechanism of the camera with the Eastman film mechanically adapted to and applied thereto."

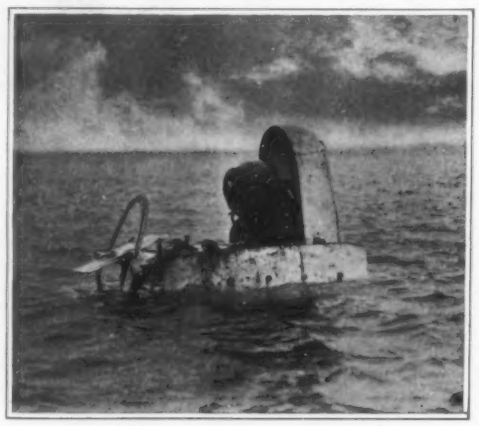
The Submarine Sledge

By the Berlin Correspondent of the Scientific American

THE diver's art has been known ever since the remotest antiquity, and even with primitive peoples there are men enabled by their personal skill and long practice to remain below the surface of the sea for a relatively long time and to bring up objects from the shallow ground. But only in quite recent times has this art made any real progress by the invention of special divers' suits, affording airtight protection from the water, and supplying the man, through a length of

The diver and his sledge.

hose communicating with the surface, with the air required for breathing. Being thus in a position to remain below the water for a considerable length of time, fully protected by safety devices, divers have in recent times rendered most valuable services to engineering and navigation, e. g., in connection with submarine building and ship repairs. Apparatus has also been invented which makes the diver practically inde-



On the point of gliding to the bottom.

pendent of the outside world; containing as it does everything required for the regeneration of the air breathed out by the man, this outfit allows of several hours' work below water.

The latest advance in this direction, however, is the submarine sledge, designed and constructed by the inventors of the self-contained diving outfit described in our issue of October 5th, 1912. This is a sledge towed by a motor boat, and on which the diver glides comfortably to and fro at the bottom of the sea, steering his vehicle vertically as well as laterally.

The submarine sledge, which greatly increases the capacities of divers, is intended to convey the man rapidly from one place to another, e. g., in searching for lost torpedoes, discovering and securing submarine mines, or handling torpedo batteries. However, its use in ascertaining the position of foundered vessels is quite as important; divers equipped with the most recent diving outfit are, on this sledge, in a position to reconnoiter most rapidly a considerable submarine region at depths down to 130 feet.

The diver, having seated himself on the sledge on board the accompanying vessel or motor boat, is lowered to the depth of the sea on a slide or by means of a davit. On two lengthy sledge runners bent up in front and connected by a curved bow are placed the diver's seat and protective shell, and to the right and left, respectively, a tank supplied with compressed air from steel cylinders. Within the front bow are arranged the elevation rudder and at the rear the horizontal rudders, all of which are actuated through a lever gear from the diver's seat. As long as the tanks are filled with compressed air, the sledge with the diver floats on the surface of the water. All that is required for diving down to the bottom, is to discharge some air from the tanks, admitting water into them or else to depress the elevation rudder, when the sledge will glide to the bottom without any violent shock. In order to return to the surface, the diver has only to raise the elevation rudder or to force the water out of the tanks with compressed air. During his course he may dive up and down at will by actuating the elevation rudder, and only on going down to or leaving great depths must he necessarily use up some compressed air. The air regenerating apparatus strapped to the diver's back contains a telephone set and is connected by a long flexible cable with a reel on the towing boat at the surface, making it possible for the diver to be in constant communication with his assistants above or those in charge of the work.

The duration of this submarine journey is dependent on the working of the air regenerator in the diving suit. The capacity of the potash cartridge, for absorbing the carbonic air breathed out by the diver, will be exhausted after about three hours, when the diver must return to the surface for a fresh potash cartridge.

The diver need have no fear of the pressure of water currents even in the case of a high speed of traveling. The protective shell behind the seat, in fact, keeps him in quiet water, the spiral water currents set up by his motion coming out behind the shell. In full daylight, no artificial lighting is required for exploring depths of about 130 feet. In order, however, to work in the dark, the diver should carry submarine lamps unless the sledge be provided with a searchlight fed with current from the motor boat. The diving equipment affords an effectual protection against accidents. The inertia of the water, by the way, makes itself felt in a striking manner on a submarine journey; the shock on the rocks or against other obstacles is damped most effectually, the strange vehicle moving in its medium with the same swiftness and docility as an aeroplane. In fact, the advent of a new sport, that of submarine travel, may be foreseen for the near future. The total weight of the apparatus without telephone is 420 pounds, and 530 pounds with the telephone transmitter, receiver and auxiliary apparatus. This equipment was utilized recently by a diver to descend to about 70 feet below the surface to inspect the intake of the electric power plant of the city of Lubeck, Germany.

Panama Pacific Exposition

IN an address delivered before the New York Electrical Society by John A. Britton, some interesting information was given on the Panama Pacific Exposition. The development of the Exposition has progressed so far, Mr. Britton said, that the work is eight months ahead of schedule time.

The first building, the Administration Building, is almost complete. The foundation has been laid for the Machinery Hall, a structure over 600 feet long and 320 feet wide. Approximately 600 acres of land over the bay shore have been filled in. About 1,500 houses that covered the site have been bought, besides a number of manufactories. The streets of the Exposition have been laid out. Already some 60,000 trees and shrubs have been planted. Soon 40,000 more will be set out.

Thus far $16,000,000 has been raised, to which some $6,000,000 was contributed by the public of San Francisco, $5,000,000 given by the State and $5,000,000 by the City. When the doors of the Exposition are opened there will be no debts.

The area covered by the Exposition will be 1,100 acres. On both sides, east and west, it will be flanked by the Government Reservation, to the extreme west by the Presidio, one of the most beautiful reservations of the Government located anywhere. A strip of land along the shore of San Francisco has been given to the Exposition and a boulevard will be built from the Exposition through the Presidio grounds to Golden Gate Park on the extreme western end of San Francisco. On the east the Exposition is flanked by Fort Mason, another Government Reservation, and by the docks recently built by the Government at a very great expense.

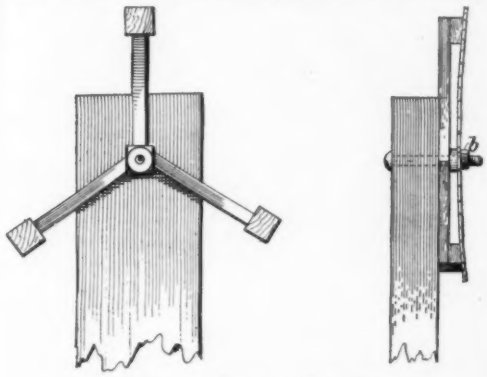
Purifying the Air in Rooms

TO purify the air of offices or sick rooms soak a few pieces of brown paper in a solution of saltpeter and allow them to dry. When desired for use, lay a handful of flowers of lavender, which can be gotten at any drug store, on a tin pan with a few pieces of the paper and light. The aroma is refreshing and agreeable and drives away insects. If hot water is procurable a few drops of oil of lavender in a glass of very hot water is good. It purifies the air at once and effectually rids the room of flies and insects of all kinds.

Holding Circular Saws While Sharpening

By William Grötzinger

THE ordinary vise or bench clamp is about the only means in the shop that the workmen know of, to hold circular saws while being sharpened. The average workman knows how difficult it is to sharpen such a saw, as the vise or clamp does not hold it firmly



Device for holding circular saws.

enough. The following method will hold the saw securely, and allow good sharpening to be done: Upon some post or leg of a bench, three arms, each about 12 inches long, are bolted. On the end of each arm, a small block is placed, as illustrated in the side view. A hole is bored through the post and the center of the arms, to allow a long bolt to be inserted. To hold the saw, place it upon the arms, and put the bolt and nut *b* in place. When tightening the nut *b* the saw will be drawn firmly against the blocks on the three arms. When filing the saw, it will not slip back or forth, as it would in the other clamps.

Some Workshop Suggestions

By B. F. Dashiell

THE following are a few workshop "kinks" that have proved helpful to the writer, who hopes they may prove equally helpful to others:

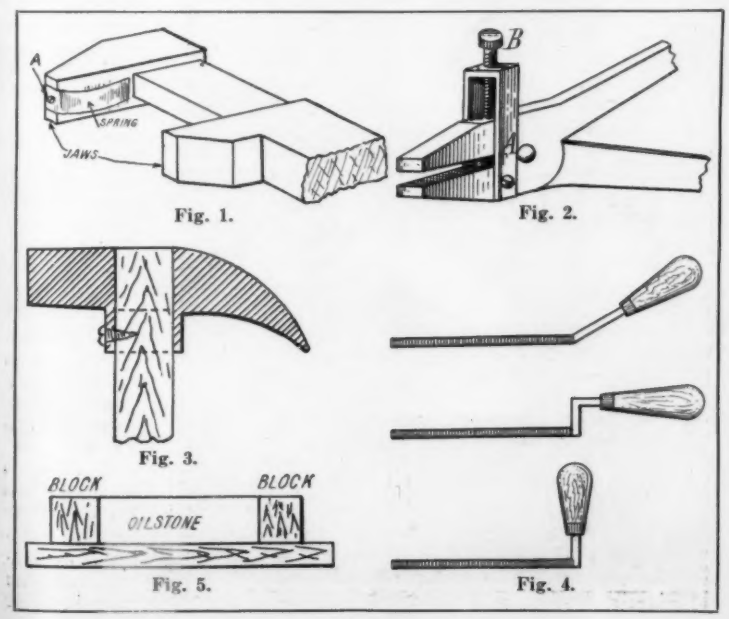
Device for Holding Nuts in a Monkey Wrench.—It is quite an advantage sometimes to be able to hold a nut in an ordinary monkey wrench, when it is to be applied to or removed from the bolt. An ordinary wrench may readily be adapted to hold a nut if one of the jaws be provided with a piece of spring sheet metal as illustrated. (Fig. 1.) This spring is preferably applied to the stationary jaw, to which it is secured by a screw. The jaw has to be drilled and tapped to receive the screw *A* which holds the spring. A slight curve is given to the spring so that it will hold the nut firmly in the jaw.

Vise Pliers.—A pair of pliers is virtually a hand vise without any means for holding the jaws in fixed position. There are some pliers, however, on the market which are provided with such a holding device and these pliers are known as vise pliers. It is a simple matter to provide such an attachment for any pair of pliers. Fig. 2 shows how this may be done. A piece of heavy strap metal *A* is bent to a U form and is fastened to one of the jaws of the pliers with a pair of small machine screws. A set-screw is threaded through the strap as indicated at *B* in the drawing. When this screw or bolt is tightened upon the jaws it holds the pliers firmly upon the work, leaving the hands free for other duties. If this holding device is applied to a pair of pliers of the parallel jaw type, the vise pliers may then be used as a wrench as well as a vise.

Fastening Hammer Heads on Handles.—The heads of hammers and hatchets have a strong tendency to become loose and work off the handle after a time. Not only is this annoying, but it is positively dangerous. A simple method of overcoming the danger is to drill a small hole transversely through the side of the hammer or hatchet to admit a small screw. The head may then be fastened to the handle by means of this screw as shown in Fig. 3.

Files for Large Surfaces.—When filing a large and flat surface, the file handle has to be raised above the plane of the work. This can be readily done by annealing and bending the handle up. The drawing (Fig. 4) shows various form of files thus bent. With such files it is then easy to go over the whole of the work and use the entire file, without having the handle in the way.

Keeping Oilstones True.—Oilstones soon become hollow in the middle due to the fact that the ends cannot be used. If two blocks of wood are glued to a base on each end of the stone the whole of it can be used, as the tools slide out on the wooden blocks. The drawing (Fig. 5), published herewith, illustrates the arrangement.



Some workshop suggestions.

Why a Plane "Iron" Has a "Cap"

By W. D. Graves

MORE completely than almost anything else are the tools of mechanics free from all superfluous parts, and there is rarely even a variation of their outline but that has material effect on their usefulness, though that effect is not always immediately apparent. The tacks driven by a cobbler do not differ much from those driven by an upholsterer; yet there is good reason for the very wide difference in their hammers, as there is also for the difference in the mauls used by the ship caulker and the stone cutter. While it may be instructive to study the reasons for these differences, even though one does not expect to "clout shoon" nor caulk ships, it is better, first, to be sure that one fully understands the significance and value of all the parts of such tools as all of us are apt to find use for. With such knowledge of the common plane, for instance, we may be able to accomplish work which would otherwise be wholly beyond us.

The thing about a plane the reason for which seems least understood is that—except in a few special forms—the cutting member is made in two parts; the "iron" proper, which does the actual cutting, and the "cap" which is slidably bolted to it. This "cap" is absolutely essential to the accomplishment of the best work with a plane; yet even some joiners do not fully understand its application. Its office is to break the fiber of the shaving, holding it down meanwhile, so that it shall be severed from the wood directly by the cutting edge rather than be torn away by a wedge-like lifting action.

To illustrate roughly let us suppose that we wish to remove, with a jacknife, a thin sliver from the top of the piece of wood *W*, in Fig. 1, in which the grain runs in the relative direction indicated by the broken lines. When practicable, of course, we would begin the cut at the right, cutting "with the grain;" but in the supposition case we will begin at the left. If we were to press the knife blade directly in from the point *A*, the split would run a little ahead of the knife edge and follow the grain to *F*. If, however, we press the blade in a little at *a*, then tilt it sharply upward, a short piece is broken off. If we now press the blade in a little at *b*, *c*, *d*, etc., breaking off a piece each time, we will eventually have roughly removed a thin layer from *A* to *B*. This is essentially what is done by the plane iron and its cap, except that the shaving, being thin, is not broken entirely apart, and being thrust downward when it is broken, it is not *pulled* away from the wood, but is first severed therefrom by the sharp cutting edge, then thrust away.

The diagram, Fig. 2, illustrates how the shaving, immediately after the cutting edge lifts it, is thrown sharply forward and broken, at the same time being pressed downward, by impinging on the end of the cap. In working hard and cross grained woods the cap is placed very close to the cutting edge, so that the breaks in the fibers of the shaving are very close together indeed. As this necessitates the taking of a correspondingly thin shaving and makes the plane push much harder, it is customary to set the cap farther back in planing softer woods with the grain, or in cases where smoothness is not specially desired. It is essential to good results that the tip of the cap be fitted very snugly against the front of the iron in order that the shavings may not crowd under it.

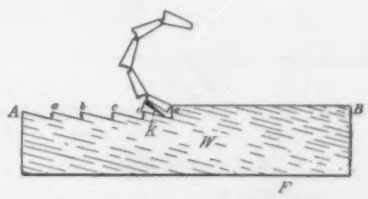


Fig. 1.—Planing against the grain without a cap.

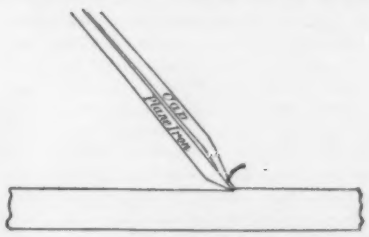


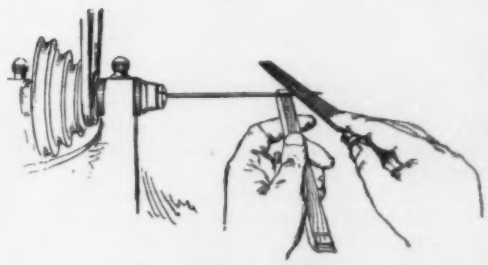
Fig. 2.—How the cap breaks the shaving.

Steady Rests for Small Lathes

By Albert F. Bishop

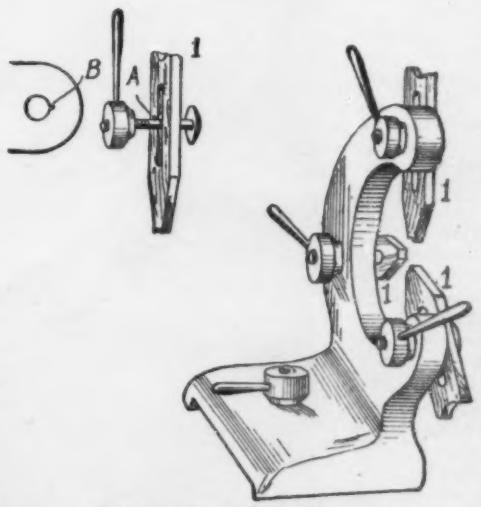
WHEN the jeweler wishes to reduce a slender wire in the lathe by filing he simply holds a piece of hardwood with a small notch in it under the wire. This will steady the wire so he can file it down quite rapidly. Jewelers prefer boxwood.

A simple form of steady rest is shown in one of the accompanying drawings. In making this rest it is necessary to construct the body of cast iron. The jaws marked 1 are made of hickory. Do not use fiber. The



The jeweler's steady rest.

hickory jaws are slotted to allow for plenty of adjustment. Small bolts pass through the jaws and are tightened with a lever nut. The bolt has a large flat head, also a small pin marked *A*, which fits in a groove



Simple steady rest for small lathes.

in the steady rest marked *B*. This groove is easily filed in. The lever nuts should be adjusted so that when they are tightened the levers will stand away from the center. This gives plenty of leeway in setting the jaws on the work.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A Machine That Washes Fourteen Thousand Dishes in an Hour

By Jacques Boyer

WITH the aid of Hamet's automatic dish-washing machine, which has been in operation for some little time in the kitchens of the Samaritaine home, in Paris, one man can rinse, sterilize and dry 14,000 plates in an hour. The machine is made of forged and drawn steel, and is very strong and simple in construction.

Its principal feature is a rotating drum composed of two hexagonal frames connected by six cylindrical rods, from which are suspended six pans loaded with dishes piled in tinned-iron racks. The trunnions of the drum turn in bearings which are mounted on opposite sides of a trough 55 inches long, 31 inches wide and 22 inches deep, containing water which is heated to the boiling point by coke, gas or steam. The height of the machine is 37 inches.

At the Samaritaine the work is expedited by assigning to the machine a number of men who wash the plates roughly by hand and pile them directly in the racks which are turned on end for this purpose, so that the plates stand on edge when the racks are again set on their bases.

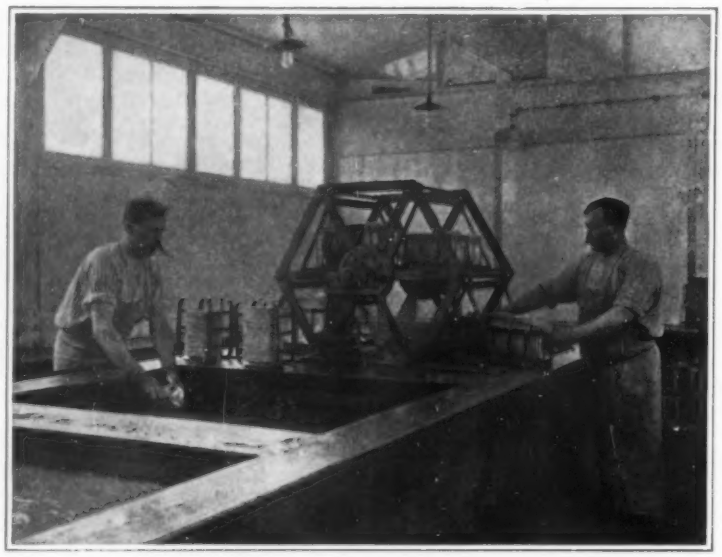
The operator of the machine puts one or two racks of plates on the nearest pan, and, by pressing downward on the bar, turns the drum through one sixth of a revolution. In this way the loaded pan is lowered into the hot water and the next pan is brought into position for loading.

When all six pans have been loaded by repeating this operation, the first pan is again in the loading position, and the plates carried by it have been thoroughly rinsed and sterilized by their passage through the boiling water, and dried by exposure to the air during the remainder of the revolution. The racks containing these plates are then removed from the pan and replaced by racks of partly washed plates, and so the operation goes on indefinitely. It is not necessary to balance the pans carefully, as the motion is controlled by a brake, which also prevents the drum from turning backward when the finished plates are removed from the pan.

It takes about 10 seconds to unload and reload a pan, and there are always two pans in the water, so that each plate is immersed 20 seconds. When two racks of 20 plates are placed on each pan, therefore, the machine turns out 40 plates every 10 seconds, 240 every minute or 14,400 per hour.

The operation of the machine requires very little effort, as the ascending and descending pans are nearly balanced. The dishes come from the machine absolutely dry and glossy, as the writer can testify from personal observation. Hence it appears probable that many hotels, restaurants, hospitals, schools, etc., will adopt this simple apparatus, which effects a great saving in labor.

For use in smaller establishments Mr. Hamet has constructed a smaller machine based on the same principle. This apparatus has only one pan which is suspended from a double scale-beam and balanced by a counterpoise. The beam turns in bearings mounted on the sides of a trough filled with boiling water. The apparatus is so constructed that the pan, whether heavily loaded or empty, remains in stable equilibrium in the loading position and also when immersed. The machine is operated by one man who roughly washes the dishes by hand and deposits them in racks. When he has filled two racks, he places them on the pan and lowers them into the water, where they remain until he has filled another pair of racks with roughly washed dishes. He then raises the pan by tipping the beam and substitutes the second pair of racks for the first pair. The rinsed dishes dry in a few seconds. With this little apparatus 2,400 plates can be rinsed in an hour, with an immersion of one minute, and the number can be increased by shortening the immersion.



Fourteen thousand dishes rinsed, sterilized and dried in an hour.

Twelve Thousand Postage Stamps Per Minute

By Thomas D. Gannaway

TO print, gum, dry, perforate, and either cut into sheets or wind into coils twelve thousand postage stamps in one minute, seems an impossible feat to even an experienced man. But a new departure in the art of plate printing is being made in the Bureau of Engraving and Printing; a change which has been sought for many years with disappointing results by practically every civilized nation in the world. The seemingly impossible feat remained unaccomplished until the completion of a machine, which was designed and built by Mr. Benjamin R. Stickney, Mechanical Expert and Designer of the Bureau, under the direction of Mr. Joseph E. Ralph, Director of the Bureau of Engraving and Printing. Heretofore it was necessary to wet the paper and allow it to become mellow before putting it through the press, but now it is printed dry.

Every one probably knows that the ordinary newspaper and book printing is done on raised type, while plate printing is just the reverse. The plate after being inked must have its surface wiped off clean; then the ink for the impression must be lifted by the paper out of the many fine depressions in the plate.

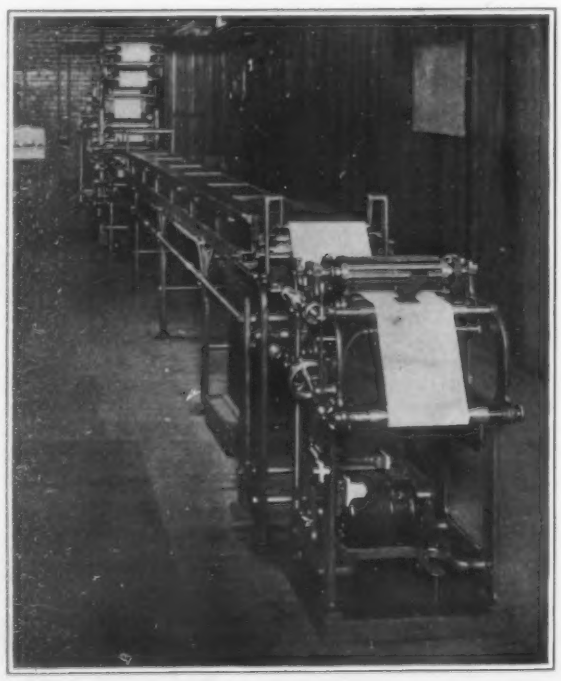
Moistening the paper renders it soft so that with a moderate pressure in the press it may be forced into the depressions in the plate and thus pick up the required amount of ink to make a perfect impression. It requires a tremendous pressure to accomplish the same results on dry paper; a pressure that cannot be obtained on an ordinary plate printing press. In the old process, as the paper has to be wet and allowed to mellow, the printing cannot be done on a continuous roll, but sheets have to be used.

Until two years ago, when Mr. Stickney invented a machine for wetting paper on which money was to be printed, all paper for plate printing had to be wet by hand. A wet rag is placed between every twenty sheets of paper, and they are then put under slight pressure in stacks of 1,000 sheets and allowed to remain over night. To distribute the moisture more evenly these bunches of twenty have to be taken out and split in the middle, turning the wet sides together, and then re-stacked with a new set of wet rags and allowed to remain under slight pressure for another night, after which the rags must be removed.

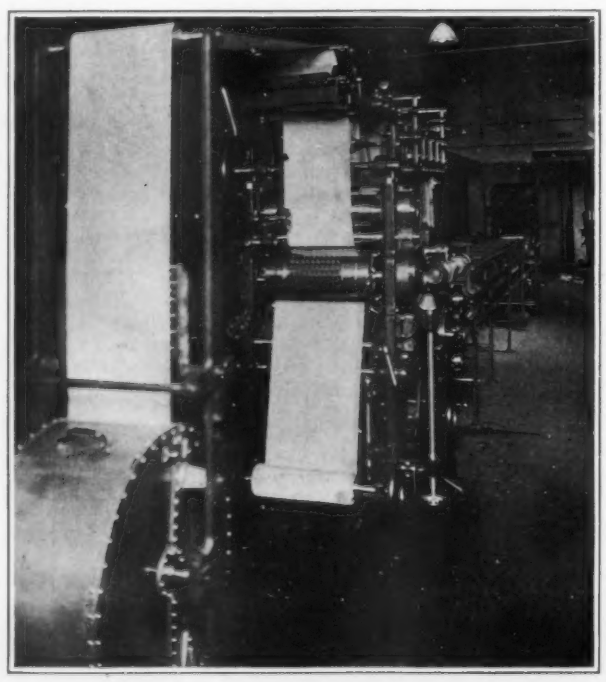
Mr. Stickney's new invention does away with all this labor, as it prints from a continuous roll of dry paper. There being no sheets to handle as the process of manufacture is going on, there, consequently, is no necessity for the many counts of sheets as in the old method.

The new machine eliminates nineteen operations in the manufacture of postage stamps and will work a saving of about 57 per cent of the present cost of them.

The process is as follows: The roll of paper is placed in a holder which stands off a few feet from the machine and then passes overhead to the top of the press, then down between the feed roller and the printing cylinder. This feed roller is so arranged, that by turning a small wheel, a tremendous pressure can be put on the top of the printing cylinder where the paper passes over it, thus enabling the printing to be done on dry paper. Just back of, and half way up the side of the printing cylinder is the inking fount. At the bottom of the printing



Delivery end of the postage stamp printing machine.



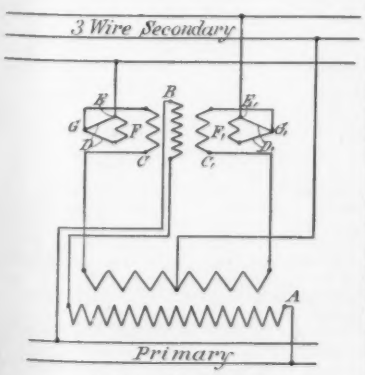
Feeding the paper to the printing cylinder.

cylinder are a number of metal fingers, or a flexible arrangement, which covers a space about eight inches wide and the full length of the cylinder. They are so constructed that they vibrate back and forth lengthwise of the cylinder. Passing over this is a wiping belt which vibrates with the metal fingers at high speed and at the same time moves slowly forward, thus carrying away the ink as it is wiped off and at the same time insuring a clean portion of the cloth to polish the engravings on the cylinder as the ink is wiped off. This is accomplished by having the wiping cloth move slowly from the front of the cylinder toward the inking fount. As the engraving leaves the point of contact with the wiper, it is evenly wiped and polished as nicely as if it were done by hand. The paper passes from the printing cylinder to the top of the machine again, and through a group of ten electrically heated cylinders where the ink is dried. From here it passes to the gumming fount, where it is automatically gummed, and passes from there into the steam-heated drying shaft, which is about twenty-five feet long. This shaft has a series of rollers and belts in it which carry the stamps through to the perforator. As they pass through this shaft the gum is dried, and by the time they reach the perforator, they have dried sufficiently to permit of packing. They enter the perforator from the drying shaft and then the slitter and coiler, where they are cut into ten strips of the width of one stamp and coiled into coils of the desired size. This portion of the machine may be changed so that it will cut the roll of stamps into sheets instead of slitting and coiling it.

The manufacturing of our postage stamps is a much larger task than the average person has ever dreamed of. It takes about forty millions of postage stamps (of all denominations) per day to supply the American people. Is it any wonder that efforts were made to devise some more rapid means of printing them? In the course of a few years' time the new machine will have saved the Government several millions of dollars on the cost of postage stamps alone. The passage of the postal savings and parcels post acts has greatly increased the demand for stamps. Of course, this increased demand can be more easily met by use of the new machines than would have been possible under the old method. The introduction of a few reforms like this will certainly make penny letter postage possible.

A Network Protector

IN the distribution of alternating current for light and power in congested communities, it is the common practice to group the customers, extending the low voltage or secondary distributing main over a considerable area, installing transformers of large units at convenient points, and interconnecting them on both the primary and secondary sides. While this system has



A network protector.

the advantage of improving the voltage regulation, it also possesses the disadvantage that in case one transformer burns out, causing a short circuit on the system, the primary fuse of the defective transformer is at once blown, dropping the unit from the line, which the remaining transformers are called upon to pick up. Also the transformer will draw a short circuit current from the secondary line, which further increases the load on the remaining transformers. The nearest transformer will take up most of the load, causing its fuse to blow which in turn will cause the fuse of the next one to burn out, and so on through the entire system. To overcome this defect, an inventor has devised the protector shown in the accompanying diagram. At *A* is a commercial transformer, one terminal of the primary being connected in series with a coil *B* of a current transformer. The terminals of the secondary of the commercial transformer are each connected through its own coil *C* and C_1 on the current transformer. These latter coils connect to the middle point of the looped fuses *D* and D_1. One side of the fuses connect from *E* and E_1 to the outer conductors of the 3-wire network. The fuses *D* and D_1 act as a short circuit connection on coils *F* and F_1. The function of this combination is that under normal conditions, the currents in the primary *B* and the secondary coils *C* and C_1 having the same ampere turns and connected in opposition will neutralize each other so that there will be no m. m. f. circulating in the core of the current transformers to energize the coils *E* and E_1. This balance of conditions is maintained at all loads and is only upset by a reverse current flowing from the secondary network into the transformer, as is occasioned by a short circuit in the latter. This condition immediately reverses the relative polarity of the coils *C* and C_1, thus energizing the core and causing a heavy short circuit current to flow through the coils *E* and E_1 by way of their short circuiting fuses *D* and D_1. The heavy short circuit current through the fuses immediately ruptures them and isolates the main terminals at *G* and G_1. A supply of current sufficient to blow the *V* fuse is obtained with a reverse current in the secondary of about one quarter full load current on the transformer. The defective transformer will thus be instantaneously cut out and disconnected from the line, allowing the remaining transformers connected to the network to continue their function, taking up the load of the defective transformer with no resulting interruption in the service.

Simplified High-potential Apparatus

By Our Berlin Correspondent

THE writer a short time ago had the good fortune to see a most interesting and useful apparatus developed by William Dubilier on a recent trip to the Continent, where his radio-telephonic system is to be adopted by the governments of several countries.

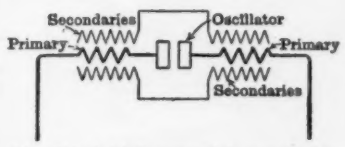
This apparatus purports to place the use of electric waves for X-ray treatment and photography, and for other medical purposes, within the reach of everybody. It is free from any heavy and complicated devices, so that it requires but one operator and may be worked by a layman as well as by an expert.

The apparatus is based on Dubilier's method of producing undamped oscillations with an uneven amplitude as used in his wireless telephone. It is contained in a box of 15 × 9 × 8 inches and comprises two transformers, a quenched-arc oscillator and a small condenser. Though only weighing 15 pounds, it allows a heavy discharge of over 6 inches to be obtained.

Each of the transformers, which are designed on entirely new principles, contains two secondaries with a primary coil between them, which are so constructed as to produce very little magnetical leakage. The core traverses the center of these coils, and these are so wound and arranged as to obtain resonance. A small variable quencher or oscillator is used as an interrupter which is so designed that its resistance always varies so as to obtain a large transformation of energy. This oscillator is so connected with the primaries that the inductance of these coils with variable currents is less than in the case of one continuous coil. The current is regulated by means of a small screw which changes the mean length of the oscillator.

With a primary current of 2 amperes and 110 volts—either direct or alternating—the discharge obtained from the secondary is sufficient to operate large X-ray tubes for photography.

The problem of insulation is solved by using a vacuum drying and impregnating apparatus with a layer of solid, pure insu-



Simplified high-potential apparatus.

lating material between each two layers of the secondary. The machine is of remarkably low weight, and therefore can be readily carried to a bedside.

The Maxim Motorboat Silencer

MUCH space has been given in the newspapers to the silencer for motorboats invented by Mr. Hiram Percy Maxim. Inasmuch as foreign patents are pending, it is impossible for us at the present writing to give a detailed description of the invention. However, Mr. Maxim informs us that the silencer is entirely different from any of the so-called mufflers in common use on motorboats. Mufflers accomplish only a diminishing of the sharpness of the exhaust and do not really silence it, he claims. They accomplish the former by providing an expansion space and a tortuous outlet passage. Their effect is only that resulting from slowing down the velocity of the gas as it issues into the atmosphere.

Mr. Maxim states that the noise of the exhaust of a two-cycle engine consists of two separate noises—a fact generally unknown up to this time. One of these noises, called by him "the primary noise," is originated close up to the exhaust port of the engine, where the gases issue at an extremely high velocity. Whenever any object passes through the air at a velocity in excess of the velocity of sound a sharp "crack" noise is developed. This was first made apparent when the Maxim silencer was used on firearms. Although the silencer would entirely eliminate the report produced at the muzzle of the gun by the powder gases, there was a noise heard out in the air beyond the gun, whenever the bullet velocity exceeded the velocity of sound. The exhaust gases from a gas engine, when they discharge, have a velocity considerably in excess of the velocity of sound and, therefore, originate a "crack" noise. This noise, having once been started, advances at the normal velocity of sound and travels on through the ordinary muffler, and, issuing at the discharge pipe, makes the sharp sound we hear when a motorboat passes. The ordinary muffler is powerless to annul this noise. In the Maxim silencer this noise is "trapped" and entirely dissipated before reaching the outlet. The result is an approximately silent exhaust.

We are informed that very interesting tests have been conducted with the new silencer on engines attached to a dynamometer to determine its effect upon horse-power output. On a dynamometer, we are told, there is absolutely no loss of power indicated. Water is injected into the silencer from the water circulation, and this keeps the silencer always cool. The silencer can be used without water if desired.

Tests conducted on a boat in the Connecticut River are of particular interest. The method of test consisted in starting a boat from a landing stage with instructions to the pilot to keep going straight away until a flag waved by the observer on the landing stage indicated that the sound of the exhaust could no longer be heard, whereupon the boat was to return and report the distance traveled by log. It was found with the best of several mufflers on the market that the boat was able to proceed roughly one mile before the sound of the exhaust was entirely lost. The same boat then had its muffler removed and the Maxim silencer substituted, Mr. Maxim claims, and was started off again. At a distance of approximately 100 feet the sound of the exhaust was entirely lost.

The diameter of the new silencer for all engines up to 25 horse-power is 6¾ inches. For engines up to 4 horse-power the length is 14 inches. For engines up to 8 horse-power the length is 17 inches. For engines up to 15 horse-power the length is 25 inches. An idea of the weight of the device can be obtained from the statement that the 17-inch long silencer weighs 24 pounds.

In the construction of the silencer there are no holes or small passages to clog. In their passage through the silencer, the exhaust gases add themselves to gas traveling in the same direction, and this is the principal reason for the absence of back pressure.

Notes for Inventors

Expansion Chamber for Pneumatic Tires.—Automobile tires frequently burst or blow out because the pressure of the air rises above the limit of safety owing to the heat generated by the friction of rapid travel or sudden contact with an obstacle in the road. In the ordinary tire there is no provision for taking up the excess pressure due to variation in temperature in the confined air, and this is liable to produce injurious strains in the tire which greatly shorten its life. Recently an inventor has patented an improvement, No. 1,035,207, which consists in providing a reservoir at the hub of the wheel that communicates with the tire. This reservoir is made of elastic material which is kept under pressure by a spring-pressed plate. The pressure of the springs is sufficient or equal to the pressure of the air in the tire. Any excess of pressure in the tire results merely in compressing the springs. In this way bursting pressures are compensated and the danger of shocks and blows is avoided.

Changes in the Patent Office Force.—Principal Examiner C. C. Stauffer, for many years in charge of Division 15, has resigned from the Patent Office. Principal Examiner G. P. Tucker has been transferred from Division 35 to Division 15, Mr. Stauffer's old division, and Principal Examiner A. D. Merritt has been transferred from Division 40 to Division 35. The resignation opened the way for the appointment of a new principal examiner, Mr. Herbert Lewis, who has been assigned to and taken charge of Division 40 in which he has long been the ranking assistant. Mr. Lewis is a native of Haverhill, Mass., a graduate of Amherst College, class of 1891, and Massachusetts Institute of Technology, 1893, and prior to entering the Patent Office had experience with the Westinghouse Electric Company in Pittsburg and in Boston as electrical engineer. Entering the Patent Office in 1894 as an assistant examiner, he served in Divisions 8 and 11 until promoted to first assistant in 1907, when he was assigned to Division 40 and has continuously served in such division until promoted to principal examiner. Mr. Lewis, therefore, has a special advantage in being schooled and experienced in the class in his charge.

A Shaving Brush That Cannot Fall Over.—In design patent No. 43,250, David H. Watts of Olden, Pa., shows a shaving brush, the handle of which has at its end opposite the brush proper a flattened surface on one side in a plane diagonal to the axis of the handle so that the brush can be supported at an incline with the brush proper elevated off the table, washstand or other surface upon which the brush may be rested.

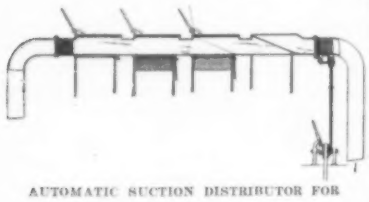
How to Mend a Moving-picture Film.—In patent No. 1,044,258, Edward J. Schafer of Seaside, Ore., shows a film-repairing machine in which clamps are provided for retaining the film on a table and pressers hold the film down on the table on opposite sides of the break, the table being transparent, and means being provided for illuminating the table and film, thus aiding in the repairing operation.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

AUTOMATIC SUCTION DISTRIBUTER FOR GINNING PLANTS.—B. REED, Box 62, Mansville, Okla. The invention provides a suction pipe having a pair of passageways. Each of these is adapted to have a plurality of openings in the bottom through which the cotton is discharged. A baffling screen is adjacent each opening and is movably mounted so that the same may be moved into the path of movement of the cotton for directing it to any opening. A movable floor is provided for each opening for preventing entrance of cotton under certain circumstances. The openings are in pairs and open into chutes which merge into a single discharge pipe, to which is connected a gin whereby when cotton is fed to either of a single pair of openings the gin is receiving cotton. A longitudinal vertical section through the invention is shown in the engraving.



AUTOMATIC SUCTION DISTRIBUTOR FOR GINNING PLANTS.

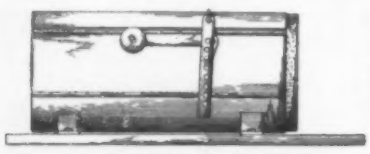
PLANT SETTING DEVICE.—H. R. GLOSSOP, Friday Harbor, Wash. This device has a rotatable member with clamps for holding plants, the clamps being opened by a trip when the plants carried by the clamps are disposed in a furrow in the rear of a furrow opener. Press wheels are secured to the device for filling the furrow after the plants have been disposed in position and a water nozzle is opened periodically to supply each plant with water as the device is moved along the ground.

HAY PRESS.—E. L. WETZIG, Clint, Tex. The inventor provides means in a press for reciprocating the plunger at regular intervals, and wherein the connection between the operating means and the plunger is of a character to transmit a high proportion of the power of the motor with a long working stroke and a quick return.

EVENER.—WILLIAM C. HOPPES, Dawson, Neb. The principle advantage possessed by this evener is that when attached to a plow the draft animal walking in the furrow has his trace chain connected at a lower level than the other animals, so that he will have as straight and direct a pull as they. The device consists of two bars, one six inches above the other, with a link connection at one end. To this link at any desired adjustment vertically thereon a double-tree is connected while the opposite ends of the bars each are provided with swingle-trees. The two bars are so connected that the pull of each animal exactly balances the pull of all the rest.

Of General Interest.

DEVICE FOR HOLDING MEAT.—F. BRIGGS, 45 Bryant St., N. W., Washington, D. C. This device for holding meat is shown in the engraving in a side elevation, and is especially adapted for that class of meat or hams which are cooked and compressed in cylindrical cooking vessels, and is adjustable to rolls of different sizes. Both ends of the receptacles are preferably open, so that after the roll of meat is clamped therein it may be pushed out at either end for the purpose of cutting off slices, and in this operation the end of the receptacle will form a guide for the knife so that the slices will be cut evenly.



DEVICE FOR HOLDING MEAT.

RACK.—O. LYNNE, 226 Helmen Bldg., New Orleans, La. This invention relates to racks to hang or hook onto a radiator and to operate as a combination drying rack, foot-rest and hook shelf. The device is portable and adjustable to be attached to and detached from steam, hot-water, gas and electric radiators to allow principally of a convenient and comfortable warming of the feet without burning the shoes or feet. It may also serve as a chair for warming the back.

FLUME CONSTRUCTION.—J. H. MARTIN, National Hotel, Joliet, Ill. The intention here is to provide a device adapted for use with current motors in Mr. Martin's co-pending application Nov. 22d, 1911, of which the present case is a division, wherein a support is provided for the motor, and in addition means for concentrating the current on the waves of the motor, and wherein means is provided for cutting off the current partly or entirely from the motor, and for fending drift or the like that might strike or injure the motor.

HYDRANT.—T. H. BALLARD, 622 6th Ave., Durango, Colo. This device has a rotatable valve at the inlet, and a removable seat cooperating with the valve and means for equalizing pressure on the valve, and having a peculiar character of port in the valve to insure maximum flow of water with minimum amount of rotation, together with means for limiting rotation of valve to a quarter turn, and for pressing the valve into the seat to compensate for wear.

LADDER.—W. F. MCSTAY, care of W. O. McAllister, 45 Bridge St., Moncton, New Brunswick, Canada. This improvement relates more particularly to a wire ladder made up of a number of similar units, the construction and arrangement, however, being such that a rigid article is produced. It is made up of a number of similar links rigidly connected together whereby the ladder may be picked up from a horizontal position into a vertical one without coming into folded position.

SHAVING BRUSH.—M. W. KENADY, 1235 Taggart St., Portland, Ore. This brush has a hollow handle, forming a reservoir, which is slidably mounted in a tubular member, to which the brush is secured, so that valve mechanism connected with the handle and the tubular member will be operated when the handle is moved relatively to the tubular member to permit the liquid soap contained in the fountain to flow to the brush.

INHALER.—G. A. EVANS, 909 Bedford Ave., Brooklyn, N. Y. This invention relates to a vaporizing inhaler, and more particularly to one designed for the treatment of diseases of the nose, throat and lungs. It regulates the amount of air fed through the same and provides means for regulating the medicinal strength of the impregnated air. It provides an outlet tube for a device having means for regulating the expiration of air from the lungs.

TURPENTINE APRON.—W. O. DALY and L. LERIO, 69 Anthoney St., Mobile, Ala. The two sections of the apron are fitted together edge to edge when applied for use. The anchor section is a narrow strip of metal with a saw tooth edge which is driven into the tree, which facilitates the application of the apron, and forms a secure support for the other or body section which is fitted to the outer edge of the anchor section. When the apron is used on a tree which has been faced off the anchor section may be employed, while on a curved tree, after a straight section has been started into a tree, it may be tapped on its outer edge to bring it into curved form to conform to the curved tree.

METHOD OF AND MEANS FOR PROTECTING THE BORES OF HEAVY GUNS FROM EROSION.—F. N. DU BOIS, Catskill, N. Y. The aim of this invention is to obviate the defect of erosion by a method of and means for applying a coating of metal under pressure to the eroded portions of the walls of the bore at or after each discharge of the gun, whereby a fresh metallic surface is presented thereby to the action of gases and heat.

Heating and Lighting.

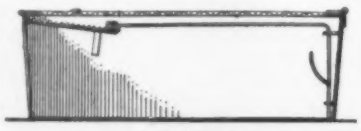
STOVE.—W. F. PINKERTON, Millbrook, Wyo. This fire-cage is especially for use in burning straw, weeds, cornstalks, chaff, grain, screenings, dust, waste paper and other trash and refuse. The invention is an improvement upon Mr. Pinkerton's former patent No. 985,058, and provides a stove better adapted for burning fuels in a green or wet condition and also for burning the particular kinds of fuel before specified.

BLOWPIPE TORCH.—A. J. EDDY, 365 Chelsea Ave., Long Branch, N. J. The invention provides means for preventing the boiling over of fluid liquid, or super-saturation of the supply wick therefor; provides means for manually supplying the fuel to the wick; and provides a simplified means for threading the wick in the torch structure.

Household Utilities.

HINGE FOR DAVENPORTS OR SOFA-BEDS.—J. SONTHEIMER, 1146 Emerson St., Lincoln, Neb. An object of the invention is to provide a hinge structure for use with sofa-beds adapted to properly connect the seat and back frames and the base, and at the same time admit of easy manipulation of the front and back in moving the same from one position to another.

ANIMAL TRAP.—T. V. CLAPP, 346 Main St., Springfield, Mass. The purpose here is to provide a trap having a rod pivoted on a vertical axis, and disposed for moving in a horizontal guideway, the rod being bent forwardly with its forward end disposed substantially in alinement with the plane of the guideway, so that when the forward terminal of the rod engages the underside of a flange on a horizontally hinged door, the door will fall, when the rod is moved rearwardly, or to either side by the animal pushing back or to either side the vertical portion of the rod to which bait is secured. A side sectional elevation herewith shows the trap with the door open.



ANIMAL TRAP.

GAS STOVE ATTACHMENT.—C. P. ELLIS and P. O'DONOHOE, 321 4th Ave., North, Nashville, Tenn. This improvement relates generally to attachments for gas stoves and more particularly it involves a device adapted to cooperate with the gas cocks in order to prevent accidental turning of the same, thereby preventing the escape of gas when so desired.

AUTOMATIC PIPE RELIEF.—J. K. PEACOCK, 92 Lockwood Ave., New Rochelle, N. Y. In plumbing systems in houses, and especially in the systems constituting the water heating apparatus, it frequently happens that the water in the pipes freezes, or due to other reasons, abnormal pressure is set up in the pipes which ruptures the latter and often results in flooding the house. To overcome this disadvantage means are provided for relieving the pressure on a pipe at a predetermined point.

Machines and Mechanical Devices.

PAN MAKING MACHINE.—W. O. DALY and L. LERIO, care of Lerio Turpentine Cup Company, Mobile, Ala. This invention is an improvement in pan making machines, and has for an object, among others, to provide a machine which can be operated by man power and thus be adapted for use by the consumer of the pans so that he can make pans as desired from sheets of metal.

ROCK DRILL.—T. J. BARBRE and J. G. TREFZ, care of Western Machinery & Manufacturing Co., 1416 Wazee St., Denver, Colo. In the present patent the invention is an improvement in rock drills, of the valveless piston hammer type, actuated by fluid under pressure, and the invention has for its object a simplification of construction and an increase of efficiency.

SHUTTLE.—J. GAGNON, care of Joseph Menard, 27 Grant Block, Fall River, Mass. Mr. Gagnon's invention has for its purpose the provision of a strong, cheaply constructed shuttle without lateral openings or cuts, and wherein means is provided for permitting the shuttle to be quickly and expeditiously threaded, and for preventing accidental unthreading.

ICE MAKING DEVICE.—M. WALINT, P. O. Box 156, West Berwick, Pa. An object of this invention is to provide means whereby a number of blocks of ice may be quickly and cheaply manufactured through the agency of a freezing compound. A further object is to provide a machine for manufacturing ice which will accomplish the freezing of the water in very short time.

Railways and Their Accessories.

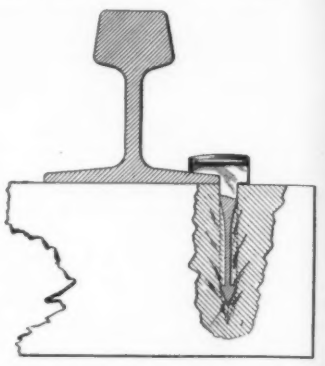
STATION INDICATOR.—W. B. HILL, Hotel Seneca, San Francisco, Cal. This improvement has for its object the provision of a device operated automatically by fluid under pressure or the like, and actuated either from the motor or the axle of the car, or from an independent wheel running on the rail.

SWITCH STAND.—S. F. PHILIPS, care of Goldstein & Miller, El Paso, Tex. The intention here is to provide a signal device for use in connection with the operating mechanism of a switch, for indicating by a visible signal the position of the switch, and means for operating the signal so arranged that the switch operating mechanism cannot be operated until the signal is set at danger.

RAILWAY TIE.—W. G. HOWE, 1772 Walker St., Des Moines, Iowa, and D. J. McDonald. This invention provides ties wherein the life of the article is prolonged; provides ties in part constructed of concrete, the concrete being reinforced to support surface strains; provides a structure adapted for rapid installation; provides cushions for the railway rails; provides cushions for the rails, interposed between the rails and concrete structure to save the said rails and structure from the extra wear by pounding of the rails on the ties; and provides fastenings for securing the rail to the ties, which fastenings are readily installed in position. The engraving shows a vertical longitudinal section of the tie, showing in full lines and in section a railway rail in service position, and in broken lines a rail in position preliminarily set for adjustment to service position.

RAILWAY TIE.

SPIKE.—W. R. RIGGINS, Foreman Extra Gang No. 6, G. H. & S. A. R. R. Co., Box 54, Sierra Blanca, Tex. This spike has recessed sides provided with a lower side wall whereby when the spike is driven into the tie the material thereof may come into engagement with the spike in the recesses and the said side walls thereby holding the spike securely. It has a double pointed end, the material of the spike longitudinally thereof between the tapering portions of the pointed end being removed, whereby the material of the tie, when the spike is driven into place, will engage with the sides of the spike, thereby holding it securely in position. The device is shown in partial vertical section in operative position.



SPIKE FOR HOLDING RAILS ON TIES.

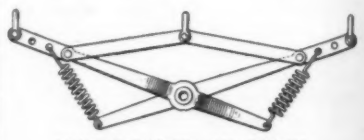
RAIL FASTENING.—G. H. WRIGHT, 6 Lorne Terrace, Halifax, Nova Scotia, Canada. The purpose in this case is to provide means for holding a rail in position on ties in such a manner as to cause the weight of the rail and the weight of a train moving over the rail to cause the fastening to more tightly retain the rail in position.

Pertaining to Recreation.

TOY WAGON.—E. C. SEEREITER, 939 Michigan St., Buffalo, N. Y. This wagon can be readily moved about and used as a sand or dirt wagon. It is built of easily separable pieces to allow a child to readily take the article apart and reunite the pieces and rebuild the wagon, thus furnishing means to occupy the child and give it educational training.

Pertaining to Vehicles.

DRAFT EQUALIZER.—D. M. MURKEN, 227 E. 70th St., Manhattan, N. Y., N. Y. This draft equalizer is adapted for use on trucks or other vehicles, drawn by either one, two or three animals pulling abreast so that the leverage will be equalized, the invention involving a plurality of levers in pivotal relation with each other and also articulated through the medium of springs. The equalizer is adapted for use with one, two or three swingle-trees, it being desirable in some instances that the animals used with vehicles be changed at short notice, and the structure of the device is particularly adapted for such change. The accompanying engraving shows a plan view of the device.



DRAFT EQUALIZER FOR TRUCKS.

SEARCHLIGHT.—H. SALSBURY, 124 Long Acre, London, England, and T. WHITAKER, 14 Blandfields Street, Balham, London, England. The intensity of a beam of light projected from a lamp is here increased without adding to the size or power of the burner. A greater cone of light from the front of the flame is utilized than has heretofore been possible, this light being caused to fall on the main reflector so that the intensity of the beam produced by a given burner is greatly increased.

Designs.

DESIGN FOR A HANDKERCHIEF.—EDITH M. MINER, Colville, Wash. Inside the border of this ornamental design is a large field marked with numerous squares of relatively small size. Between the four sides of this centerpiece and the border are duplicated groups of a girl and two animals connected with one another.

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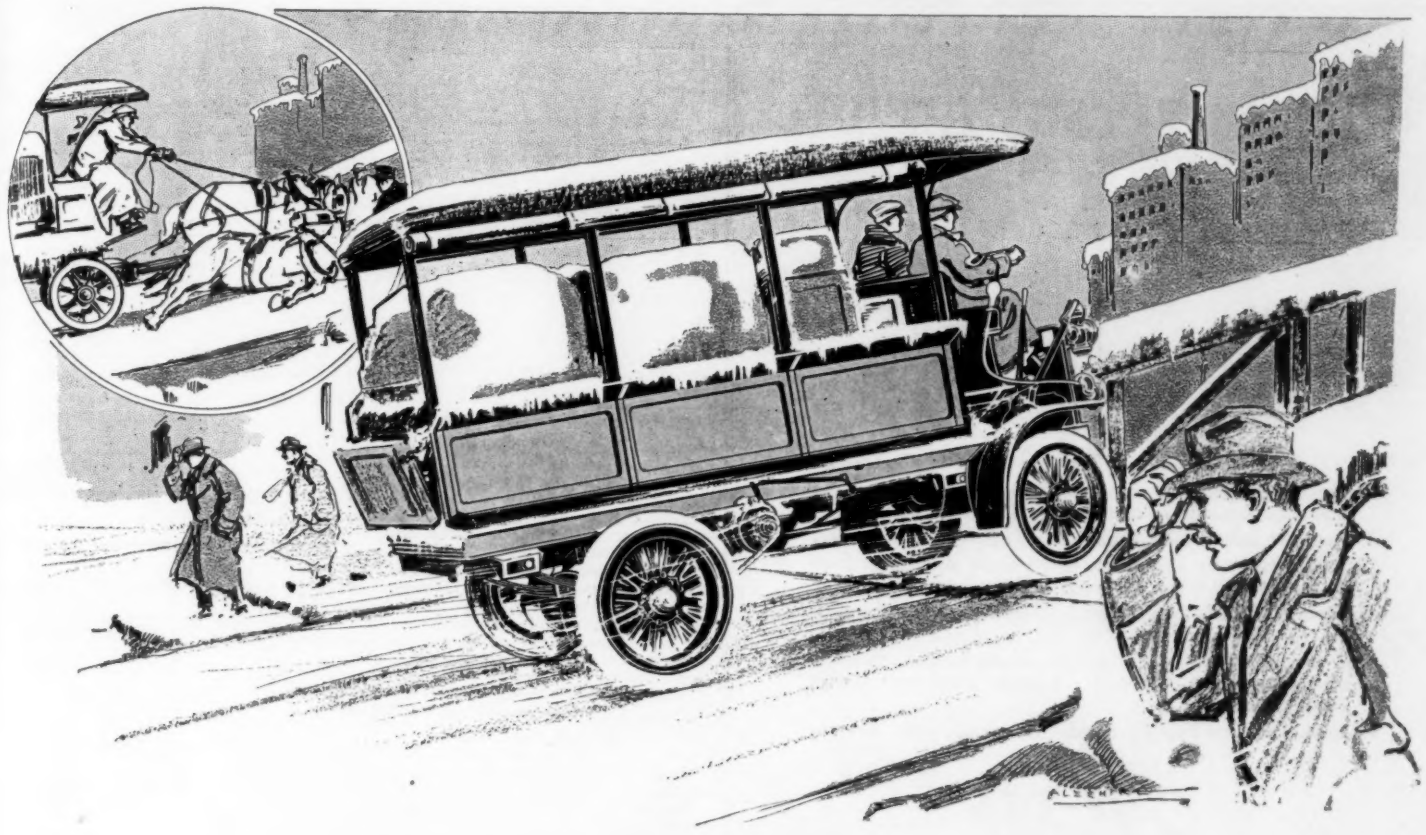

GRAMM TRUCKS

Anticipate and prepare

WHEN the temperature goes *down* your horse-hauling expense goes *up*. The first flurry of snow *forces your horses to work slower than ever*. The first ice coated pavements are responsible for the thousands of accidents, falling horses, maimed horses, and horses that have to be shot.

The piling up of snow in the streets means *fewer* deliveries per mile, *smaller* delivery radius, and *more* out of patience customers. The huge snow drifts that form in the outlying and suburban districts, which your horses are absolutely unable to buck, mean a transportation expense, which, in the eyes of ordinary business judgment, *is a rank extravagance*. The cost of hauling merchandise (by horse) in the winter has, in some instances, been found to be greater than the profits on the goods delivered.

Winter, to the horse-hauling man, means perishing horses, damaged equipment, costly veterinary bills and big losses due to dissatisfied customers. Those merchants and manufacturers who still stick to the horse, lose hundreds of thousands of dollars every single winter, *which can be saved*. As you cannot change or control the weather the solution lies in *changing your equipment*.

The Gramm truck is as efficient in zero weather as it is in June. And in June one Gramm truck can do the work of at least three first-class teams. In some cases one Gramm truck can accomplish as much as four and even five teams, but this varies, according to the nature of your business.

Gramm trucks will plow clean through big snow drifts, without a bit of effort; will not be affected by a gale or a blizzard; cannot slip, slide or fall; operate as easily over icy pavements as over asphalt; do thirty miles of work at 10° *below* zero as readily as at 70° *above;* in short, *will make as many delivery stops in the teeth of a terrific snow storm as on the fourth of July*.

The rapid approach of winter is something every transportation man must face. Anticipate a little this winter. Think *now*, not after the season is too far advanced. Prepare for what you know is *bound* to happen. Be ready for the *most costly hauling period of the year*.

The Gramm truck has been in use for over ten years. It is built by practical truck builders in the largest individual truck plant in America. It is the most highly developed and practical truck built. We have studied transportation requirements and problems for years. What you are up against we can solve.

We will be glad to send our nearest representative or maybe you would prefer to call. Gramm transportation plans, equipment, facts and figures are worth your most careful consideration.

All advice and information gratis.

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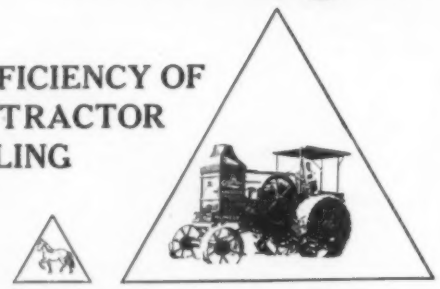
The Gramm Motor Truck Company, Lima, Ohio

Rumely Bulletin No. 3

Muscle versus Engine

RELATIVE EFFICIENCY OF HORSE AND TRACTOR IN HAULING



As a hauling-engine, the Horse has been beaten by the Tractor.

The cost of hauling with Horses is 23c per ton mile; while the cost of hauling with Tractors is only 10c per ton mile.

Our units of freight have become too large for Horse-hauling.

Sixteen Horses were required to haul a single steel girder from the freight-shed to the Woolworth Building.

One tractor, for less than half the cost, could have done the work of these sixteen horses.

Our tonnage has become too great for Horse-hauling. A single ore-boat carries 12,000 tons. A single wheat train carries 100,000 bushels.

We must move from Muscle to Engine—from small, feeble Horses to

RUMELY OILPULL TRACTOR LA PORTE IND

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Rumely Products Co.
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See next week's Bulletin

377

Trade Marks

Trade Names

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(12711) D. M. C. asks: I claim that a 30-inch wheel, the periphery of which runs two miles a minute, has a greater centrifugal force than a 90-inch wheel with its periphery running two miles a minute. Am I right? A. The centrifugal force of a rotating body is given by the formula $F = \frac{m V^2}{r}$. m is the mass, V is the velocity, and r is the radius, or distance of the weight from the center of rotation. In the case which you propose the weight is not given, the rim velocity of the two wheels is the same, and so does not cause any difference between the two wheels in the result. There only remains the radius to be considered, and the larger the radius the smaller the centrifugal force, other factors being the same. Therefore, the larger wheel, if of the same weight as the smaller, has only one third the centrifugal force of the smaller. It may aid to the understanding of the question to consider that the small wheel has a much larger angular velocity than the larger with the same linear velocity of the rim. It turns through 360 degrees in one third the time of the larger wheel; but this does not affect the centrifugal force.

(12712) G. W. P. writes: In Query No. 12,692, H. E. C. describes the formation of thin conducting chains by the passage of current through a metal powder. This effect was first observed by Tommasina, and described in *Comptes Rendus*, December 12th, 1898. An abstract of Tommasina's article in the London *Electrician* of January 13th, 1899, reads as follows: "*Electric Cohesion.*—T. Tommasina has observed a peculiar phenomenon of adhesion or cohesion under the influence of the electric current, which may serve to elucidate some obscure points in the properties of coherers. He was engaged in experiments with an elementary coherer in the shape of a simple pendulum with a bob of nickel-plated brass resting lightly on a pinch of nickel filings, supported by a horizontal copper plate. The coherer was inserted in a circuit operating a relay, which lighted a small lamp when the current passed. The author found that when the copper plate was lowered the connection between the pendulum and the nickel filings was not immediately broken, but was maintained by a mobile and flexible little chain of filings, sometimes as long as 2 centimeters. Only one such chain was formed at a time. While it lasted it continued to keep the lamp burning. On cutting off the current the chain collapsed in a short time. Filings of several metals were tried, and it was found that the chains were readily formed by the noble metals, but not by iron, magnesium antimony and bismuth. The author does not attempt an explanation, but if the phenomenon is due to electrostatic attraction, it is evident that the contact between the particles must be very intimate indeed, and this is more likely to be the case in noble metals than in others. Note that both Tommasina and H. E. C. were unable to form chains of *iron* filings. A. We had not seen the citation from the *Comptes Rendus* when we prepared the note in question, and very gladly give the credit to Tommasina for the original observation of the curious phenomenon.

(12713) C. E. W. writes: As a subscriber for over thirty years, and an occasional contributor, I venture to take exception to your answer (12691) to F. S. in your issue of November 2nd. Is this quite an adequate explanation? If it were true that all trees "grow toward the light and warmth of the sun," then every tree would point its top toward the *celestial equator* (for that is the sun's mean place) and would furnish a fair guide to the approximate latitude of the place where it stands. But the line of a tree's normal growth is *vertical*. The "light and warmth of the sun" hardly accounts for this, it seems to me. A. We do not think there is much difference between your statement and ours in regard to the growth of a tree. We say that trees in forests grow vertically because of the influence of surrounding trees cutting off the light on the sides. Trees growing in small clumps or alone grow out on all sides, while the top extends up and away into the light, which comes in *every* direction from the sky, and not simply directly from the celestial equator as you state it. There is sufficient light on the north side of a tree to influence the growth of the terminal buds on that side, and to cause, in general, an upward turn to the branches. Our statement was evidently not intended to be a complete discussion of heliotropism, but only a sentence giving the general tendency of vegetable growth. A sprout on a potato in a cellar always turns toward the window, as we learned in our years of boyhood upon a farm in New England. There can be no question regarding the influence of the warmth of the sun upon the larger growth of the rings of wood on the south side of the tree trunk, and the wider spread of the branches to the south in the northern parts of the country. We thank you for your communication.

(12714) H. C. C. asks: I wish a description of a machine running with the power that a gasoline engine does, but only uses electricity generated by a dynamo that is run by the machine itself, after being started on dry batteries, if there

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MUNN & CO., INC.

Inquiry No. 9285. Wanted factory, store, shop or bank articles to sell by canvassing at a profit of from $1.00 to $5 00.

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Inquiry No. 9288. Wanted the names and addresses of concerns that can coat steel balls with pure tin one-sixteenth of an inch thick.

Inquiry No. 9289. Wanted substance melting at 225° and hardening when cold without imparting any flavor to tobacco smoke and without emitting any oil, or fatty vapor.

Inquiry No. 9290. Wanted name and address of a manufacturer of a patented device which is suitable for making up pay envelopes, namely, to fold up bills and insert them with minor coins in a pay envelope of the usual size.

Inquiry No. 9291. Want to buy machinery for manufacturing wooden tooth picks.

Inquiry No. 9292. Wanted a gum that will stick labels to grape-fruit;

Inquiry No. 9293. Wanted the names and addresses of manufacturers of waterproof cloth, also samples of such cloth

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is such a machine invented. I have been informed that one of that description was on exhibition some time ago, the object of which was to run motor boats without the expense of gasoline. I write for information to find if such a machine has been invented and put on the market. A. We feel sure that no such machine as you describe can be successful, since a dynamo cannot produce electricity enough to run a motor and also to run itself as a generator, after starting it with a dry battery. Such arrangements have been tried many times and have always failed. No more power can come out of any machine than is put into it; nor even as much, since some power is always consumed in turning the machine itself, that is, in overcoming inertia and friction. If you are interested in the various ways in which men have tried to produce perpetual motion, we would refer you to our SUPPLEMENT, Nos. 1130, 1131, 1133, 1135, 1136, 1137, 1138, price ten cents each. They are fully illustrated.

(12715) W. D. J. asks: Will you kindly advise the common metal which has the least expansion from heat? Also the metal (common) which has the greatest expansion from heat? These metals should be able to withstand heat of 600 or 700 degrees without deterioration. A. We give you herewith the relative expansion and the melting point of several of the metals, having the least and the greatest expansion. They are taken in part from Kent's "Mechanical Engineer's Pocket Book," which we send for $5.00, and in part calculated from other sources. If the numbers given as relative expansions have four more ciphers prefixed, with the decimal point removed four places to the left, they will become coefficients of expansion, giving the amount of expansion for 1 deg. Fahr. per unit of length.

Metal.	Relative expansion.	Melting point, Fahrenheit.
Wrought iron	0.0646	2,740 deg.
Cobalt	0.0685	33,000 "
Nickel	0.0695	2,730 "
Copper	0.0887	1,900 "
Silver	0.1079	1,742 "
Aluminium	0.1234	1,157 "
Magnesium	0.1407	1,427 "
Zinc	0.1621	779 "

We would not warrant any of these metals not to deteriorate if kept at a temperature of 600 to 700 deg. Fahr. in the presence of moisture.

(12716) C. D. I. asks: It occurs to me that there must be a very decided gyroscopic effect from the rapidly revolving flywheel of an automobile motor. Placed as it usually is directly behind the radiator and parallel thereto, what would be its effect upon the motions of the car, and how powerful would this effect be? It would be interesting to me, and doubtless to many others, if you would answer these questions through the columns of the SCIENTIFIC AMERICAN. A. The flywheel of an automobile engine has, as you suppose, a gyroscopic effect upon the machine. Its numerical value depends upon the weight of the wheel and the speed of its rotation. It is not so great that it is difficult to steer the car. Some have tried to account for certain accidents in this way, but we doubt if the attempt is a success.

(12717) J. A. B. asks: In the electrolysis of water, where the poles of the battery end in two separate test tubes, filled with and inverted under the water for collecting the hydrogen in one and the oxygen in the other, how does the oxygen atom manage to travel to one tube and the hydrogen molecule pass over to the other tube? If the water molecule is decomposed at a point half way between the poles, and outside the tubes, would not the two gases form a bubble and rise directly to the surface of the water, and thus escape into the air? Or if the decomposition occurred at either pole, how does the gas liberated travel over to the other tube without escaping up through the water? I have tried to find these things explained in the new Encyclopedia Britannica, but the subject runs into ions, and right there I stop. I never fail to read your Notes and Queries, and often find the most valuable information, along the very lines upon which I had desired more light. A. Do not be afraid of an ion. It is quite innocent. It is simply a small particle of a substance which is carrying a charge of electricity on its back. It is moving about. The word *ion* means *going*, a traveler. Now hydrogen ions carry positive charges, and oxygen ions carry negative charges. When a little sulphuric acid is added to the water, a great many ions appear. They are somewhat different from simple hydrogen and oxygen, but we will let that go this time. They are there in the water all loaded and traveling about, a busy hustling multitude, jostling one another about. Now send a direct current of electricity through such a hubbub of traveling ions. Immediately a steady procession of ions starts up. The hydrogen ions with their loads of positive electricity travel to the negative pole and drop their loads of electricity upon it and appear as ordinary hydrogen gas. Before they were invisible ions. They become visible as gas when they lose their loads of electricity. The same is true of the oxygen ions. They unload and are just oxygen gas. No bubbles of gas can be seen in the liquid. No gas is seen until the loads of electricity are given up, and all the action seems to take place on the poles. We cannot explain the electrolysis of water or anything else without our ions, little travelers, and one who would understand and enjoy modern science has just got to get acquainted with them. They are great jokers, mischievous little Brownies, but they are quite ready and glad to make your acquaintance. They are among the most important little bodies in the chemical world. We scientists are very fond of our little ions, and they do us many a good turn to pay us for our attentions to them. Now you will not be afraid of ions.

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How to realize economy with a motor wagon: Practical suggestions to those who have had experience in handling only dray horses.

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1644—Soldering and Soldering Processes, gives broad general information, and contains in particular a method for pulverizing solders and alloys of great use.

1667—Some Soldering Appliances, describes the blow-pipe and the furnace in their various forms.

1481—Soldering of Metals and Preparation of Solders gives many formulas for soft and hard solders and fluxes.

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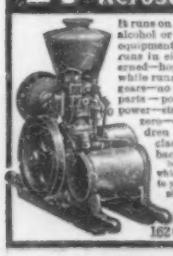

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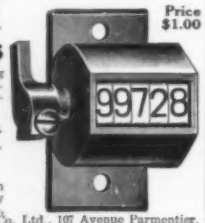

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NEW BOOKS, ETC.

COLONIAL HOMES AND THEIR FURNISHINGS. By Mary H. Northend. With numerous illustrations. Boston: Little, Brown & Co., 1912. 8vo. Price, $5 net.

Miss Northend's name is a familiar one to magazine readers. For some years she has been a steady contributor to the more important home magazines published in this country. As a writer on the home and its decorations, she has thoroughly familiarized herself with architectural styles and with furnishings. All this experience and knowledge is reflected in the book before us. Lavishly illustrated and beautifully printed, it conducts the reader into many of those historic dwellings of New England which may be regarded as the acme of architectural perfection and of good taste in interior decoration. There can be no question that Miss Northend has collected a valuable amount of material, which is here presented in such form that both the professional architect and decorator and the general public can profit by it.

THE MODERN GASOLINE AUTOMOBILE. Its Construction, Operation, Maintenance, and Repair. By Victor W. Page, M.E., Consulting Automobile Engineer. Formerly technical editor of the Automobile Journal. 500 illustrations; 10 folding plates. 694 pages, size 6 x 9 in. New York: Munn & Company, Inc., 1912. Price, cloth, $2.50.

Now that the automobile may be said to be standardized and its manufacture has become a national industry, it is time that a book should be published which can discuss it thoroughly and authoritatively with the assurance that the discussion will not be out of date two months after publication. Such a work Mr. Page has produced. Although other books on automobiles have been written, his may well be regarded as a product which, more than any other, is comparable with the best works on mechanical, steam, hydraulic and civil engineering. Too great praise cannot be given for the conscientious manner in which author and publisher have cooperated. The one has manifestly given us the fruits of a ripe experience: the other has printed and illustrated the text worthily.

Most automobile manufacturers and motorists will profit by a study of Mr. Page's book. First defining the trend of modern practice, the author passes to a classification of the component parts of motor cars and considers the function of each group of mechanism. The parts of typical pleasure car chassis are painstakingly described and illustrated. The reader is told how a typical chassis may be assembled, how truck parts are arranged, and is given considerable insight into the relation of wind resistance and body design. In the author's discussion of motive power, we naturally find a classification of the forms of power plants and the usual explanation of the difference between two and four cycle action. There are clear accounts of typical single-cylinder engines, the frequency of cycles in one and two cylinder engines, as well as in multiple-cylinder engines. In a modern work it is but natural that we should find considerable space devoted to the slide-valve motor, and Mr. Page has not only done so, but contrasted the slide valve with the poppet valve. A chapter which will be read by manufacturers with interest and profit is that on engine construction.

So, too, the discussion of fuels is remarkable for its exhaustiveness. Not only are the different kinds of fuels that can be employed in automobiles taken up both from their chemical composition and their mechanical efficiency, but carbureters, mixing valves, spray nozzles, are analyzed.

Equally thorough are the chapters on ignition, lubrication, clutches and gear sets, etc. Of value to the designer is the chapter on the chassis and its components. A chapter helpful to the motorist is that on practical hints to assist in locating power plant troubles.

A word must be said for the illustrations. They are all line drawings very carefully prepared, very clear, and lavishly provided with legends that name each part. Indeed, we know of no book which can compare with this in the excellence of its technical illustrations.

For its systematic and logical arrangement of subject matter we commend this book to the reader who desires to gain an understanding of the functions of each part of an automobile and the typical groups of mechanism.

BRAUNBECKS SPORT-LEXIKON. Ausgabe, a. 1912-1913. Automobilismus, Motorbootwesen, Luftfahrt. Herausgeber Gustav Braunbeck. Berlin: Verlag Gustav Braunbecks Sport-Lexikon, 1912.

This is the third annual edition of a work which more or less constant use in this office has proven to be of considerable value. In the present edition the editor has omitted the older material to be found in the previous editions, but has referred to it. In this volume are recorded all the important events which have taken place in the world of the automobile, the motor boat, and aerial navigation.

HOPSON ON AUCTION. By Francis Johnstone Hopson. The New Count "Royals." New York: E. P. Dutton & Co. 12 mo.; 86 pp.

This book is up-to-date, inasmuch as it gives in a simple and direct manner many hints in regard to playing Auction under the rules of the new count. The principal laws of team play in the new game are placed before the reader in a clear and concise manner. The laws of Auction bridge as adopted by the Whist Club, with the amendments of December, 1911, are published through the courtesy of the Whist Club.

Christmas Suggestions in Useful Books

The Scientific American Boy

By A. RUSSELL BOND. 12 mo., 317 pages, 340 illustrations. Price, $2.00.

¶ This is a fascinating story of outdoor boy life, and contains a large number of practical suggestions which, in addition to affording amusement, will stimulate in boys the creative spirit. In each instance complete practical instructions are given for building the various articles. The boy camper is supplied with directions for making tramping outfits, sleeping bags, tents, tree houses, straw huts, log cabins and caves. Winter diversions include instructions for making skate sails, snow shoes, ice boats, scooters, sledges, toboggans, etc. The more instructive subjects covered are surveying, wigwagging, heliographing and bridge building. Miscellaneous devices, such as scows, canoes, land yachts, windmills, water wheels and the like are also described. It is attractively illustrated with half tones from life and numerous diagrams and engravings drawn to scale.

The Scientific American Boy at School

By A. RUSSELL BOND. 12 mo., 338 pages, 314 illustrations. Price, $2.00.

¶ This is a sequel to "The Scientific American Boy" and like its predecessor is brim full of practical suggestions, all of which are entirely new. The construction of the apparatus, which is within the scope of the average boy, is fully described and the instructions are interwoven in a fascinating story, which makes the book interesting as well as instructive to the boy. This volume contains instructions on surveying, sounding and signalling, the building of dams, canals and canal locks, truss bridges and several different types of boats. Sun dials, clepsydras, seismographs, gliding machines, kite photography and camera hunting are a few of the other interesting subjects taken up. Other unique ideas are water kites, fish-tail boat-propellers, bicycle sleds, geyser fountains, etc. No boy of a mechanical turn of mind can read the story without being inspired to try his hand at making the devices.

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Magic, Stage Illusions and Scientific Diversions

Compiled and Edited by ALBERT A. HOPKINS. Large octavo, 556 pages, 400 illustrations. Price, $2.50.

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Handy Man's Workshop and Laboratory

Compiled and edited by A. RUSSELL BOND. 12mo., 467 pages, 370 illustrations. Price, $2.00.

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Home Mechanics for Amateurs

By GEORGE M. HOPKINS. 12mo., 370 pages, 320 illustrations. Price, $1.50.

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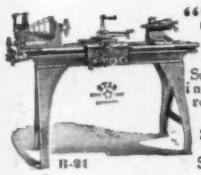

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Sending Photographs over a Telephone Wire

(*Concluded from page 529.*)

so designed that they will prevent reflections which might fog the picture. Since the elevations on the gelatin prints on the transmitting cylinder constantly displace the conducting plate of the rheomicrophone and the current that is sent through the line varies in intensity proportionally to the elevations and depressions of the original gelatin print, the mirror of the oscillograph in the receiving apparatus moves almost constantly. Because of the mirror's movement the pencil of luminous rays reflected is turned from right to left, from the center to the edge of the lens. It encounters the series of screens which reduce its luminous intensity more or less. On the other hand, since the sensitive film has been placed in the right position relatively to the mirror, the opening is continually illuminated. Hence when the pencil of rays falls on the center of the lens, the absolute transparency of the interposed screen produces no extinction whatever. The luminous impression is a maximum, corresponding with a black portion on the original print. But if the luminous rays are reflected to the edge of the lens, the absolute opacity of the screen interposed causes a complete extinction of light and hence white is produced. For all the intermediate positions of the reflected bundle of rays, the scale of screens determines the corresponding halftones and the desired photographic effect is obtained.

By various mechanical means the series of screens can be very exactly graduated and the rotation and sensitivity of the oscillograph controlled. The image received conforms absolutely with the original. In one of the accompanying illustrations we reproduce a picture transmitted over a line 450 miles long.

Solution of the Steel Rail Problem

(*Concluded from page 533.*)

of each grade steel were made; they forged well and were found satisfactory.

TABLE I. WASTE AND USABLE PRODUCT FROM 14 MILD-STEEL INGOTS.

	Per Cent.
Head scrap	6.0
Billet scrap	1.0
Forge waste	1.8
125 billets	91.2
Total weight, 15,400 lb.	100.0%
Total waste	8.8%

TABLE II. WASTE AND USABLE PRODUCT FROM 14 MEDIUM-STEEL INGOTS.

	Per Cent.
Head scrap	5.6
Billet scrap	0.7
Forge waste	1.6
126 billets	92.1
Total weight, 15,340 lb.	100.0%
Total waste	7.9%

In conclusion, attention is drawn to the four illustrations at the bottom of page 533, showing the results obtained with an eleven-inch ingot, weighing 1,650 pounds. It will be noted that when the ingot had been rolled down into blooms aggregating thirty feet in length, it was necessary to discard only two feet six inches. A section at the inner end of this discard showed only a slight evidence of pipe. A section at a point one inch farther down the bloom showed absolutely sound material without any sign of pipe.

Now here is a process, which, if it were adopted by American rail manufacturers, would enable them to furnish the railroads with a rail that was absolutely sound and free from the lurking menace of piping. The inventor has found that the decreased cost per ton due mainly to reduced discard is from two to three dollars. We believe the present price of rails in the market is about $28 per ton; and we venture to believe that if the railroads, especially those in the East, where the traffic is heavier and the weather conditions are more trying, could by the payment of slightly more to cover the cost of installing the plant, secure absolutely sound rails, they would be found ready to do so. If we read Sir Robert Hadfield's paper aright, however, the total cost of the output, if it were large, would be reduced.

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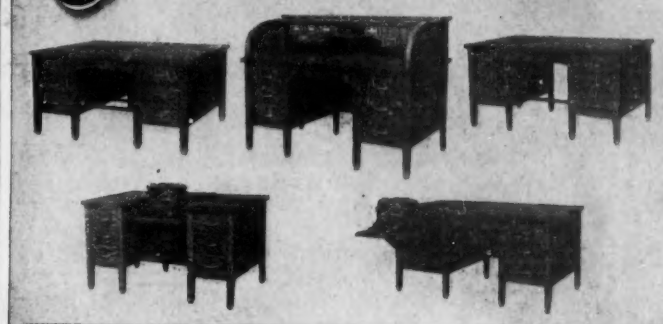
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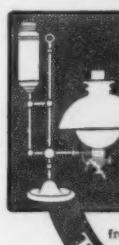
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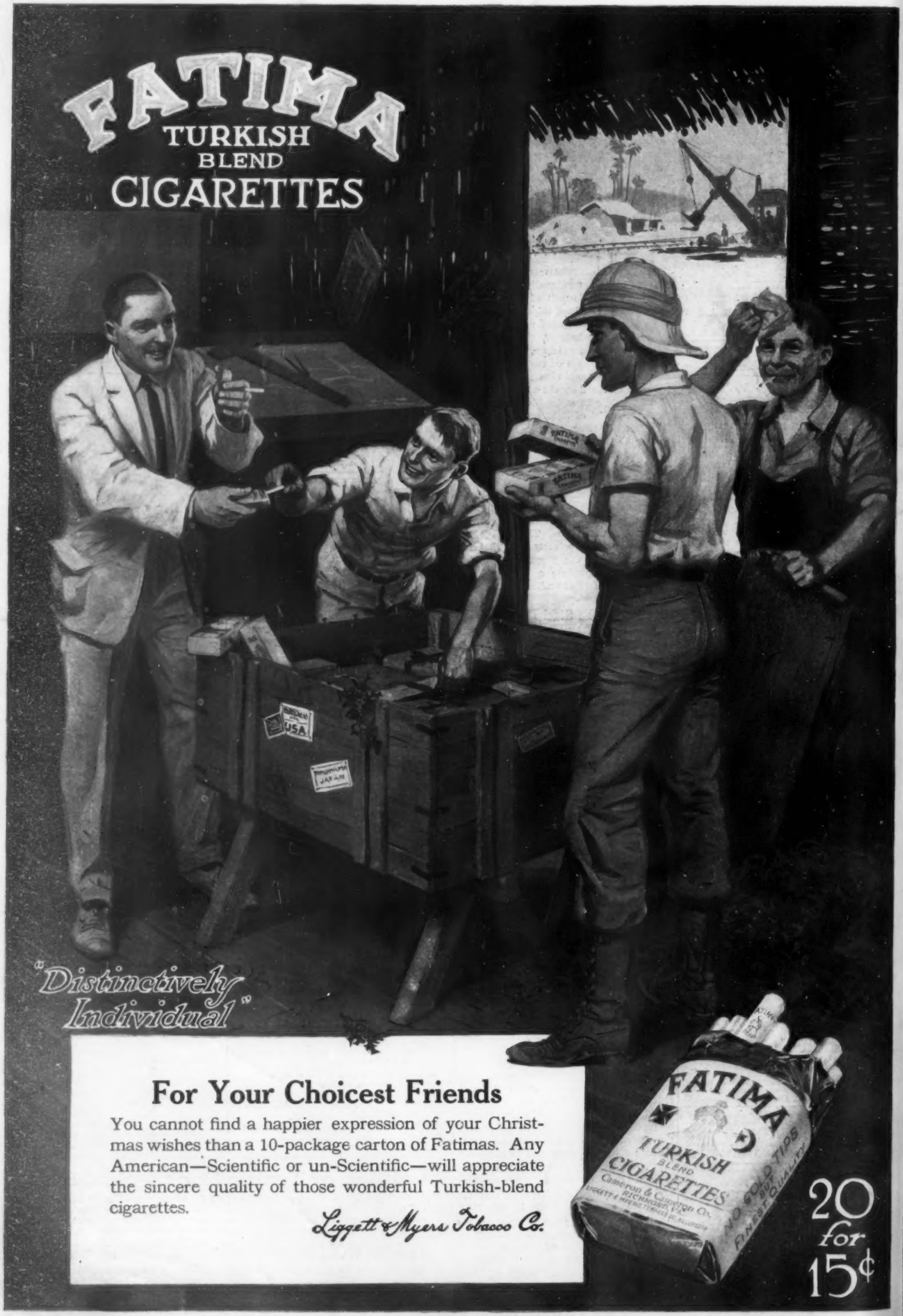
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